51-A-01

SECTION 514

ELECTRONIC PARTS RELIABILITY

OPERATIONS HANDBOOK

April 1993

Volume 1

JPL D-7724

JET PROPULSION LABORATORY

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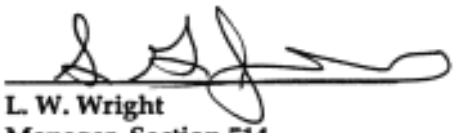
Approved by:



L. W. Wright
Manager, Section 514
Electronic Parts Reliability

JPL D-7724

JET PROPULSION LABORATORY

CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to:

- Delineate the hierarchy of requirements imposed on JPL electronic parts.
- Outline the parts selection and acquisition process.
- Outline how Section 514 interfaces with other organizations (Hardware De-signers, Projects, Reliability and Quality Assurance (R&QA), etc.) in obtaining parts that conform to the requirements.
- Outline the structure and function of the Electronic Parts Reliability Section (514), the organization tasked to implement those requirements.
- Be a reference for Section policies and procedures formulated to implement the parts requirements.

This document is intended as a guideline for achieving effective Section operation rather than a specific road map to be slavishly followed.

1.2 SCOPE

This document outlines the tasks performed by Section 514 and the methodology used to perform and manage these tasks. It is published in two volumes.

Volume 1 contains an overview of the Section, a review of electronic parts requirements, a description of parts program activities, the organizational structure, and a description of the Section's parts program management activities.

Volume 2 contains Section parts program support costing guidelines, resource requirements, and capabilities.

The requirements, procedures, practices, and policies delineated are in conformance with *JPL Electronic Parts Program Requirements for Flight Hardware,* JPL Document D-5357.

1.3 APPLICABLE DOCUMENTS

All applicable documents are listed in the *Section 514 Document Tree,* Appendix A

2.0 SECTION OVERVIEW

2.1 INTRODUCTION

Section 514 is tasked to provide services to other elements of the Laboratory in the cost effective selection, evaluation, acquisition, and use of high reliability electronic parts. This chapter presents a summary of how Section 514 implements its electronic parts activities.

The objective of Section 514's parts program is to assure that only electronic parts with reliability commensurate with the flight hardware payload classification to be fabricated, are selected and properly applied. This objective is pursued by Section 514 through implementation of a set of plans and activities that, in general, can be divided into three main categories, namely;

- Electronic Parts Technology Development
- Project / Task Specific (Direct) Support Activities
- Institutional Electronic Parts Support Activities

Direct support to specific Laboratory projects / tasks by Section 514 can be further categorized into support to in-house tasks (e. g., Galileo, SIR-C, Cassini) and support to contracted tasks (e.g., Mars Observer, Magellan). Because of the significant difference in the effort expended by Section 514 in the two cases, they are described separately. It should be noted that the term "Project" is used herein in its generic sense, i.e., a major task, and does not refer only to programs performed by the Flight Projects Office (FPO).

2.2 ELECTRONIC PARTS TECHNOLOGY DEVELOPMENT

The role of Section 514 in the development and introduction of electronic parts technology at JPL is fully defined in Section document 51-A-05, *Technology Development Plan for Electronic Parts Reliability Section 514.* This document outlines the Section's long range (5 year) technology goals and implementation strategy and is updated yearly.

The primary objective of the Section 514 technology development program is to assist the Laboratory in selecting electronic parts for use in engineering and science flight equipment. To accomplish this objective, the parts must be thoroughly evaluated with respect to reliability, quality, and the mission environments, including radiation and long life. These efforts are funded primarily by NASA Research and Technology Objectives and Plans (RTOP) funding and the Ad-Hoc Budget, funded by FPO and the Office of Space Sciences and Instruments (OSSI), with additional funding for specific part types from individual Projects.

It is important to realize that the technology objective cannot be characterized as a fixed, static goal. Rather, it is subject to continual change and updating for a variety of reasons. As NASA space systems become more complex and autonomous, the increased performance demands of these systems can be met only by more sophisticated and elaborate discrete and microelectronic devices. However, while these devices may be capable of meeting greater performance requirements, they are often more susceptible to more subtle changes that affect life and reliability. In addition, the higher performance demands can be met only by new advanced technologies for which there is no or only minimal existing data. Even if well established technologies are employed in a conservative fashion, it is well-known that minor alterations in an established part fabrication line can result in significant changes in functionality, radiation response, and reliability. Thus, it is imperative to continue to evaluate and analyze not only new

part types which may be used in future space systems, but also standard parts as well.

Following the evaluation, procurement and test specifications must be written and negotiated. The results of this process are reported and disseminated, and the parts are identified as flight worthy by adding them to the JPL Institutional Parts List (IPL) and/or the Approved Parts List (APL) for a specific project.

In general, the technology development in Section 514 consists of:

- Advanced Device Evaluation / Development
- Radiation Effects and Radiation Hardness Assurance
- Device Reliability (Test) Methodology, and
- Advanced Microelectronic Failure Analysis Techniques

2.2.1 Advanced Device Evaluation / Development

JPL Electronic subsystem designers are (directly and through the Electronic Parts Advisory Group - EPAG) regularly requested to provide candidates for electronic parts usage in future applications. Section 514 parts program selects candidate parts from available advanced electronic parts and collects and reviews all available device information, performs device characterization and test, and develops JPL parts procurement specifications to be used by flight projects for parts acquisitions. Whether the Parts Specialists are considering the part as an IPL candidate or because of developing concerns over known problems, they can propose tests or evaluations that will improve the understanding of the product and how best to direct its procurement, acceptance testing, handling, application and even failure analysis.

For emerging technologies, a limited assessment is first performed to identify deficiencies and recommend corrections to the manufacturer, where the deficiencies are correctable, thus providing additional candidates for the use of future projects.

Evaluations can range from construction analysis through environmental tests, radiation tests, tests to destruction, to long term reliability tests. Longer term problems having no immediate effect on projects are often evaluated using institutional burden funding, while project peculiar concerns are evaluated during pre-procurement and procurement phases of the project using project funding.

These evaluations are generally divided into two phases; preliminary evaluations and detailed evaluations. We typically accomplish the following during the evaluation process:

- <u>Preliminary Evaluations</u>
  - Perform literature search
  - Determine the product development status
  - Determines manufacturing sources
  - Determine applicability of product function to JPL programs
  - Perform design reliability assessments
  - Contact other aerospace firms conducting evaluation of the product

- <u>Detailed Evaluations</u>
  - Select source(s) for evaluation
  - Develop evaluation plan
  - Perform selected product and/or test evaluations

Present spacecraft electronics are designed and fabricated using individual standard components assembled onto circuit boards and packaged for specific applications. Future missions requiring greater autonomy and/or performance will put increased demands on spacecraft electronics thereby requiring new designs, methodologies and approaches to be employed. The current technology approach best capable of dealing with the high level of electronic circuit requirements is to reduce discrete circuit board designs to single silicon chips. Some of these circuits are available as off-the-shelf designs but some, having unique requirements, must be uniquely designed. The industry term for such a-customized device is Application Specific Integrated Circuit or ASIC.

The current role of the Electronic Parts Reliability Section in ASIC technology is to:

- develop guidelines for ASIC vendor evaluation, design verification, and product acceptance
- formulate and administer the ASIC component acquisition, from vendor selection through design support and verification, specification preparation and technical contract program management, to component delivery and failure analysis
- consolidate current qualification knowledge into a NASA ASIC qualification handbook or guide.
- investigate future trends in ASIC technology

This ASIC effort has been designated a Section 514 technology priority and is also detailed in the Section technology development plan, 51-A-05.

2.2.2 Radiation Effects and Radiation Hardness Assurance (RHA)

The ever increasing dependence on microelectronic subsystems to monitor and control spacecraft functions, and the increasing load of onboard data processing requires a larger variety of Very Large Scale Integrated Circuit (VLSI) devices which must satisfy radiation requirements. As a result, the Section has evolved a comprehensive program of radiation testing. Some facets of the radiation program have also been designated a Section priority as described in 51-A-05.

The objective of this program is to assist NASA Centers and Project Offices in selecting radiation hardened microelectronic parts to be used in space systems that will be exposed to space radiation environments. This objective is accomplished through testing and analysis of appropriate candidate devices and integrated circuits, followed by reporting and dissemination of the test results in easily accessible formats such as the RADATA Data Base. The two principal tasks in this effort are Single Event Effects (SEE) testing and Total Ionizing Dose (TID) testing of candidate parts. The scope of the existing effort is limited to testing of parts intended for use in NASA systems and does not include an emphasis on applied research on important test issues, nor on in-depth studies of specific device types. The RHA program expertise and equipment is also used to perform a limited amount of testing for non-NASA customers.

However, the electrical characterization and radiation testing of complex VLSI chips, such as ASICs with many thousands of gates, are becoming very expensive and time consuming, especially if one searches for and tests under "worst case" radiation conditions. Consequently, it is important to consider the use of surrogate test structures taken off the manufacturing line early, instead of actual production circuits. In addition, if such tests are performed only after the devices are obtained from the vendor, there is a high risk that the chips will not satisfy radiation

requirements. Thus, in addition to a continuing evaluation of the radiation hardness of devices for systems, it is also necessary to improve our radiation test methods and the relationship of the test methods to the actual radiation environment.

2.2.3 Device Reliability (Test) Methodology

Advances in discrete and microelectronic device design and manufacturing have led to increased functionality, smaller device feature size, new packaging technologies, etc. which, in turn, have led to new failure mechanisms which make the reliability of the product more sensitive to process variations. The role of the Electronic Parts Reliability Section is to identify these failure mechanisms and other causes of reduced reliability and to develop tests capable of detecting the presence of these failure mechanisms in electronic parts through screening and evaluation testing. As new products are developed, there is also need for new techniques for testing these parts. This technology effort is also defined in 51-A-05.

2.2.4 Advanced Microelectronic Failure Analysis Techniques

To confidently use microelectronic devices in spacecraft, one must have the ability to properly assess any associated risks. One method of risk assessment is through the determination of the root cause underlying any device failure or unacceptable degradation observed during testing of either the devices or the spacecraft hardware in which they are used.

To this end, the Section maintains an extensive failure analysis laboratory; equipped with the latest diagnostic equipment. This laboratory is used primarily to support the failure investigation of electronic parts of JPL Projects and to perform Destructive Physical Analysis of Section procured parts. However, it is also used to support other NASA Center failure investigations.

Many of the analysis tools and techniques of the past can no longer be applied to the fine line geometry devices of the future. Therefore new techniques must be developed and new tools acquired. An example of such a tool is one wherein the electrical performance of the interior of a fine line device can be interrogated via a focused electron beam.

It is desired that for future JPL projects, Section 514, jointly with project representatives, generate a list of complex ICs. The Section would then build and assemble the necessary fixtures and hardware, and prepare the necessary software to electrically interrogate the device, for verification of failure. In this way, in the event of a device failure, more rapid response to a projects fabrication schedule could be obtained.

2.3 INSTITUTIONAL ELECTRONIC PARTS SUPPORT ACTIVITIES

The Section is responsible for the generation and maintenance of hundreds of JPL electronic parts specifications, listed for reference in the *JPL Engineering Standards Reference List* (D-2003), along with the newly created Institutional Parts List (IPL) and associated policy and engineering reference documents such as the aerating criteria for electronic parts. These documents are such an integral part of the electronic parts technology evaluation process that their generation and maintenance is generally included as a task under the umbrella of technology development. In addition, there are certain other continuing, non-project specific, essential "housekeeping" functions that are also supported on an institutional basis by the Laboratory through general burden funding and through burden funding from FPO and OSSI. All Laboratory programs benefit from the output of these institutionally funded efforts even though the parts reliability program for a specific project may be unique. Without these activities, the general parts program at JPL would degrade in quality and usability. The various

program areas are summarized below.

2.3.1 Institutional Documentation

2.3.1.1 General Document Maintenance

The general document maintenance covers policy documents, as well as specifications. Part of the effort is to review existing JPL parts specifications to purge those that can be replaced by military specifications. The existing specifications are reviewed for those that are more than five years old and those that have generic parts equivalent to military specifications with qualified sources to the appropriate quality level.

2.3.1.2 Institutional Parts List

In 1987, the Electronic Parts Steering Committee (EPSC) was formed to examine issues arising in the selection, qualification, application, and acquisition of electronic parts, both by JPL and its contractors. The final report prepared by the EPSC contained a recommendation that the Preferred Parts List be replaced with an Institutional Parts List (IPL). The generation, maintenance and management of the IPL is accomplished by Section 514.

2.3.1.3 On-Line Vendor Data

Vendor data is currently obtained from the parts manufacturer in the form of hard copy catalogs and microfilm. It is planned that the catalog data will eventually become available to the designers and parts specialists via the Electronic Parts Information Network System (EPINS). This new software handling system should also improve the search and selection capabilities.

2.3.1.4 Requirements Standardization

Standardization of requirements is also supported. It comes through coordination meetings with NASA, DOD and industry, as well as internal JPL coordination not directly associated with a project.

2.3.2 Expertise Maintenance

It is necessary to continually increase the current skills of the Parts Specialists as technology progresses. To this end, training classes and guidelines are generated. Some examples are:

- Parts Specialist Guidelines
- Training classes
- Technical Seminars
- Industry peer information exchange programs

2.3.3 Electronic Parts Information Network System (EPINS)

The Section is developing software application programs to provide the flight projects at JPL with support services associated with selection, procurement, screening, and application of flight-quality electronic parts. EPINS provides custom application software to maintain current and historical data on all flight-quality electronic components that are procured for all spacecraft subsystems and instruments. The basic objective is to provide a computer-based system to aid in

the management and control of the Section's total electronic parts reliability effort, from initial parts selection through parts delivery and Failure Analysis (FA) support.

The major software applications include the Institutional Parts List (IPL), Approved Parts List(s) (APL), Pre-Electronic Parts List (PEPL), Parts Review System (PRS), Electronic Parts List (EPL), Parts Tracking System (PTS), the, Electronic Parts Quality Assurance (EPQA), Financial Analysis System (FAS), and the Management Reporting System (MRS). All of these applications are interrelated and form EPINS. The EPINS software applications are primarily DOS based and run on one of the Section's Novell file servers. However, the system will, with the exception of some Windows based applications, also support Macintosh based users on the network. Users may access EPINS and input or gather data from their computers.

The generation of this system has been a Section priority for several years. It is currently in the initial operations phase. However, some development remains to be accomplished in FY'94.

2.3.4 LSI Laboratory Maintenance

The LSI (Large Scale Integrated Circuit) Laboratory is contained within the LSI Group and has developed over the years in response to the needs of several projects, starting with Galileo. Much of the work of the laboratory is funded by projects using the services provided by the facility, but some of the operating overhead costs are funded by burden accounts. The activities of the LSI Laboratory fall into the three main categories listed below.

2.3.4.1 Device Evaluation

Prior to procuring LSI devices from a manufacturer, an initial evaluation of the devices is performed to assure that there are no reliability problems associated with the manufacturing processes. This activity includes physical evaluation, construction analysis, and wafer probing. Test structure analysis to assess the adequacy of vendor's process control systems is also supported. The equipment used for these tasks requires regular periodic updating as the complexity of LSI parts increases and the feature sizes decrease.

2.3.4.2 Test Verification

Complex LSI devices must be tested using functional test programs which detect a very high percentage of the possible faults. The probability of failure when operating in spacecraft systems is significantly increased if testing is inadequate. The LSI Laboratory includes fault simulation hardware and software which is used to verify the fault coverage of test vectors used for LSI parts. Maintenance contracts on the hardware and upgrades of the software are recurring costs of sustaining this capability.

2.3.4.3 ASIC Design Support

Prior to design of any ASIC for use in JPL flight equipment, it is essential to verify the cell libraries to be used in the design. When the design is completed and when the prototypes are delivered, additional verification steps are necessary. The design tools available in the LSI Laboratory are used to facilitate the verification of gate array and standard cell library designs and prototypes. This equipment has maintenance and upgrading requirements similar to those associated with the test verification task.

2.3.5 Electronic Parts Advisory Group (EPAG)

The EPAG is an advisory group composed of Senior electronic design engineers. The

primary function of the EPAG is to provide guidance with respect to the minimum set of specific electronic part types that need to be included in a JPL Institutional Parts List in order for it to represent a viable parts selection source for the design of spacecraft electronics. The focus of the EPAG is primarily, but not totally, on state-of-the-art microcircuit products because they are undergoing the most rapid technological change and are the most difficult and costly devices for which to demonstrate adequate reliability for spacecraft use.

2.4 DIRECT SUPPORT - IN-HOUSE PROJECTS

The Section's parts program conforms to the umbrella requirements of JPL D-5357, *Electronic Parts Program Requirements For Flight Equipment.* D-5357 is applicable to all Flight Project Office, Office of Space Science and Instruments, and Technology and Application Program (TAP) electronic parts.

The largest percentage of the Section's activities is expended in support of "in-house" projects. A typical "in-house" project schedule is shown in Figure 2.1. In general, the Section's support of such projects can be divided, as shown on the figure, into several major activities:

- Preproject (Phase A/B)
- Early Project (Phase C/D)
- Parts Selection (Phase CID)
- Acquisition (Phase C/D)
- Hardware Fabrication & Test (Phase CID)

A general schematic showing the interrelationship of the Section's various Phase C/D support activities is shown in Figure 2-2. Further details on the total parts support process are provided in Section 4 and Appendix B. *Electronic Parts Acquisition System Flow.* A detailed step-by-step analysis of the complete acquisition process can be found in 51-D-02, *JPL High Reliability Electronic Parts Acquisition Process.*

2.5 DIRECT SUPPORT - CONTRACTED PROJECTS

In the system contract mode, the system contractor has the responsibility for design and development of the flight system. As a subset of his overall responsibility, the system contractor is responsible for implementation of an adequate parts reliability program. The objective of this parts reliability program is also to assure that electronic parts are properly applied and have reliability commensurate with the payload classification of the flight hardware to be fabricated.

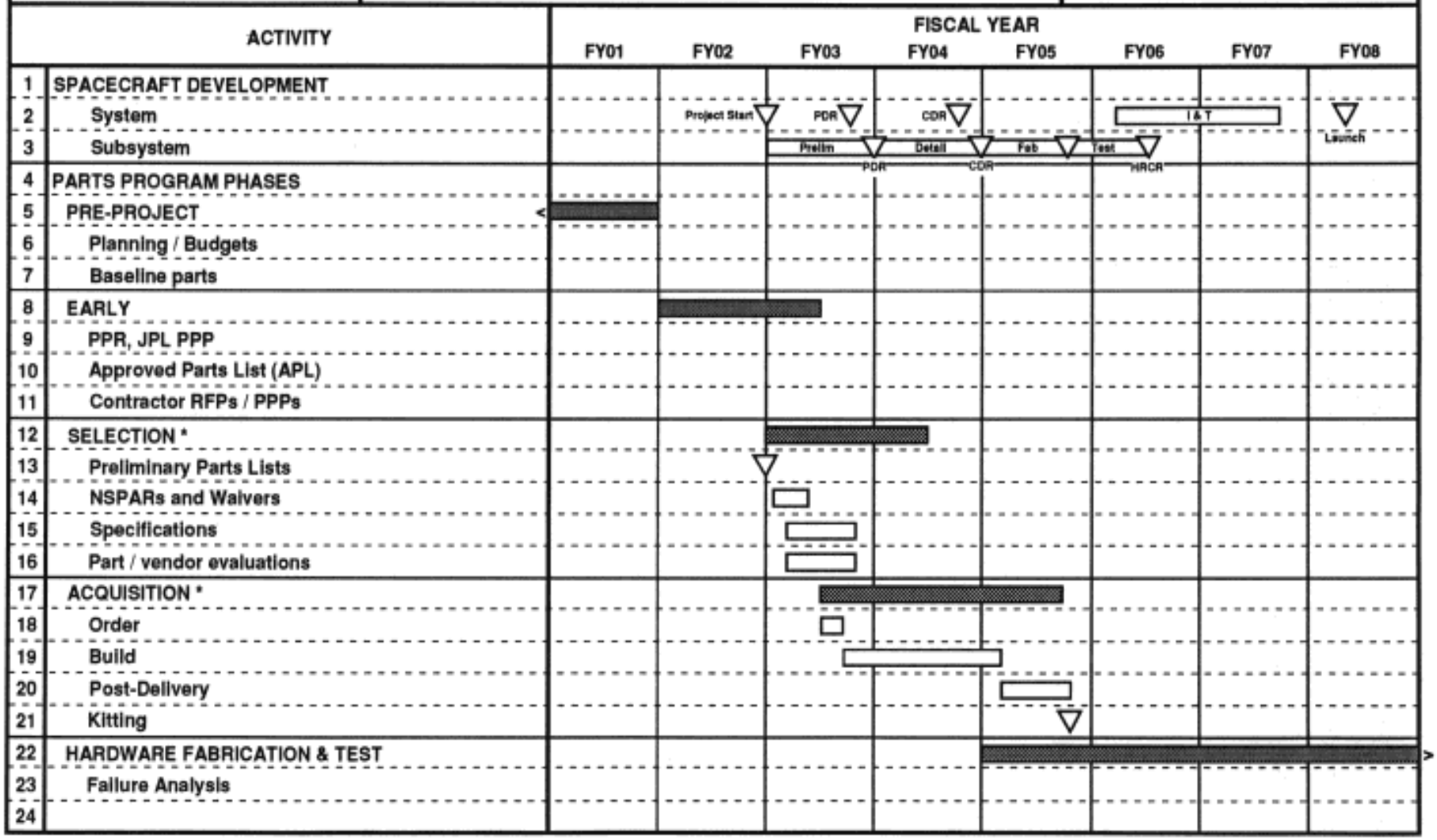
The Section's role in the system contract mode is basically one of establishing the parts reliability program requirements in conformance with JPL D-5357 and then monitoring the system contractor's compliance with those requirements. It is crucial for the contract to thoroughly describe the requirements for the parts reliability program. Consequently, it is important to assure that the ultimate contractual obligations are well defined. These activities are a subset of those described in Figure 2.1 and are described in Figure 2.3. Figure 2.3 displays JPL's interaction with the system contractor in monitoring, reviewing, and in some cases, approving elements of his parts reliability program. The single most important action by JPL is the review and approval of the contractor's Parts Program Plan since it defines how he plans to fulfill his contractual requirements.

ELECTRONIC PARTS RELIABILITY

Jet Propulsion Laboratory
APPROVAL: _____ L. W. WRIGHT
ACHIEVEMENT: _____ K. CLARK

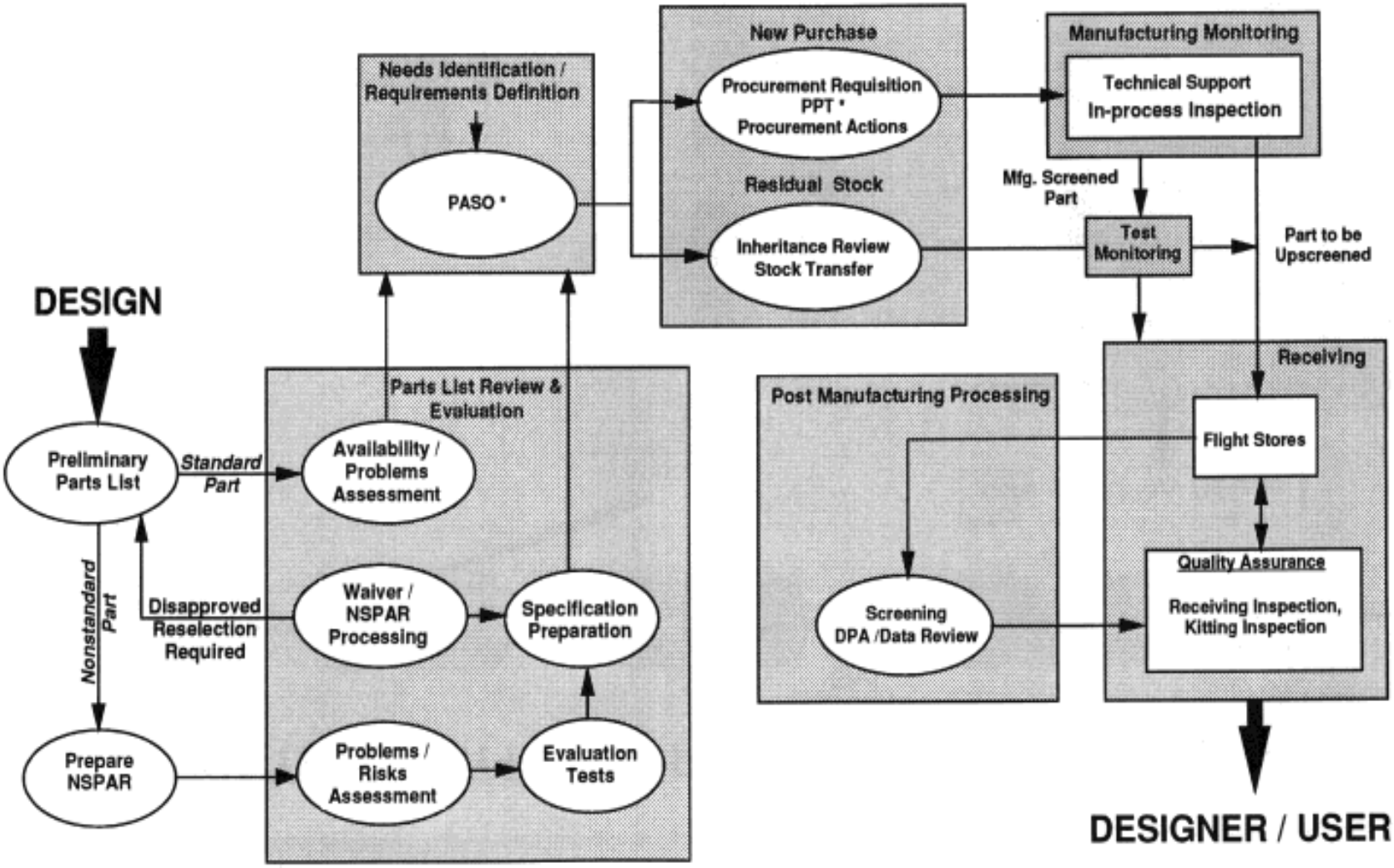
Project X
PARTS PROGRAM PLANNING

REVISION DATE: _____
CREATION DATE: _____



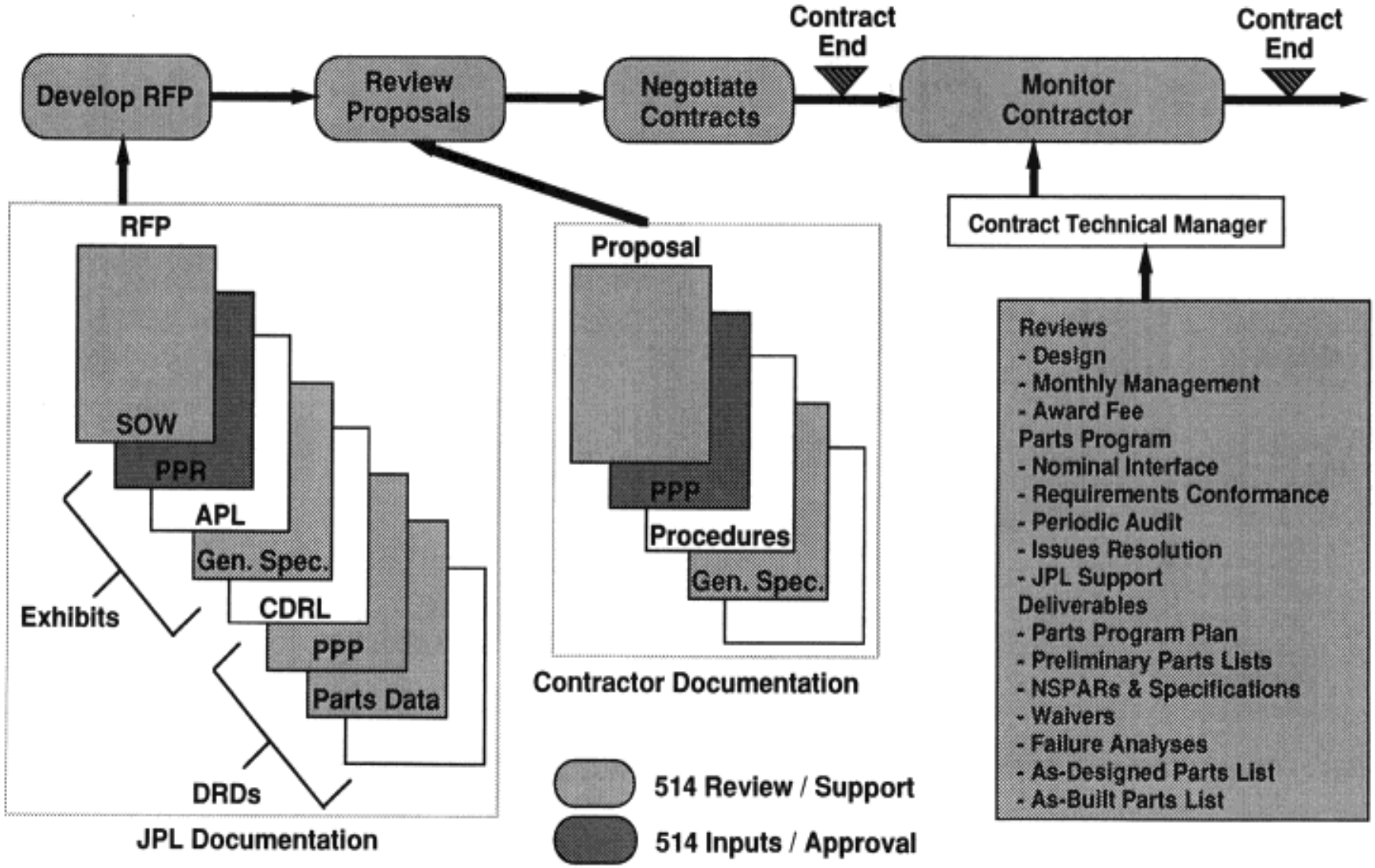
* Detail selection & acquisition shown for typical long-lead parts

PHASE C/D SUPPORT ACTIVITIES



* PASO = Parts Acquisition and Screening Order
PPT = Parts Pedigree Traveler

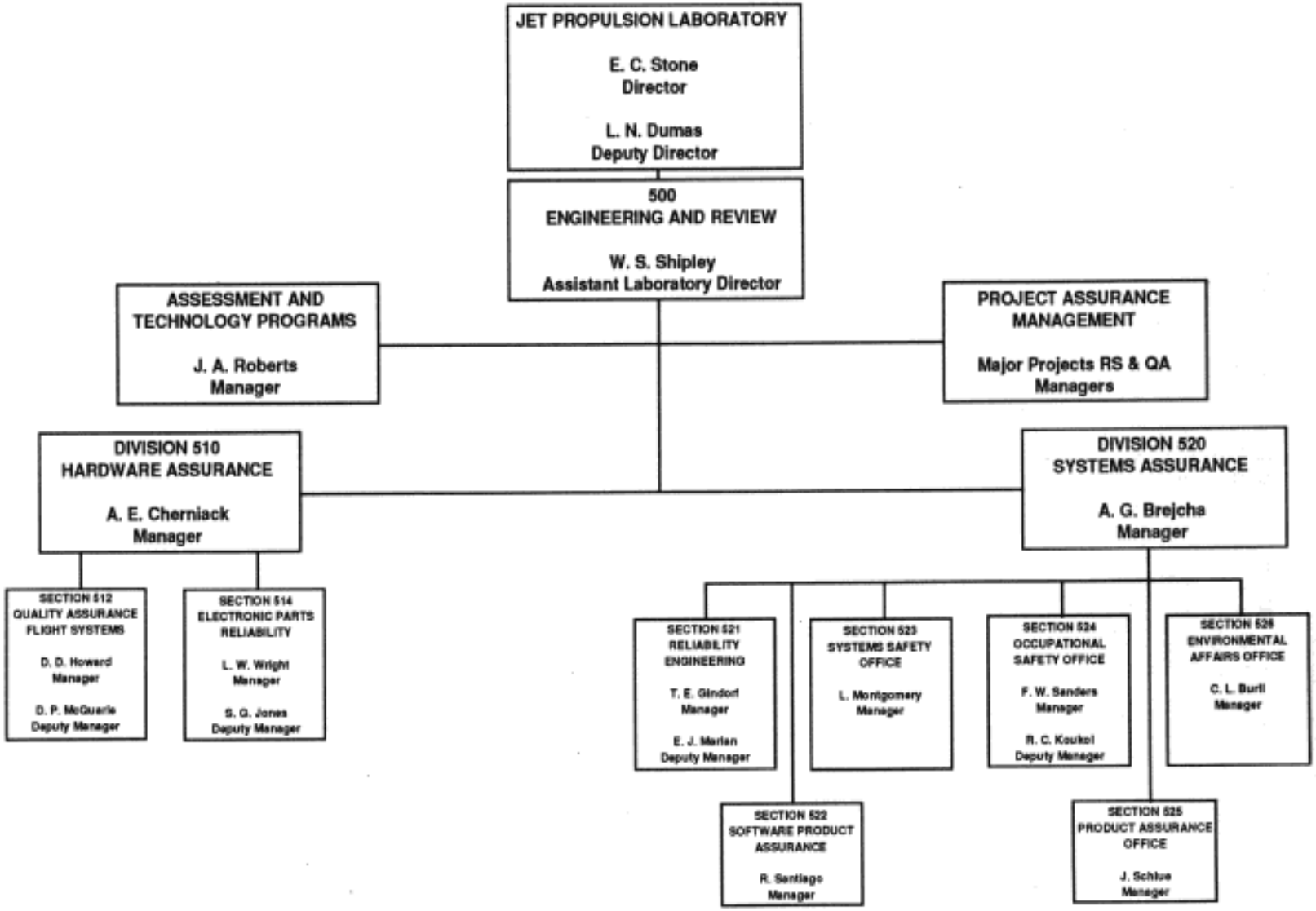
CONTRACTOR PARTS PROGRAM REQUIREMENTS



2.6 ORGANIZATION

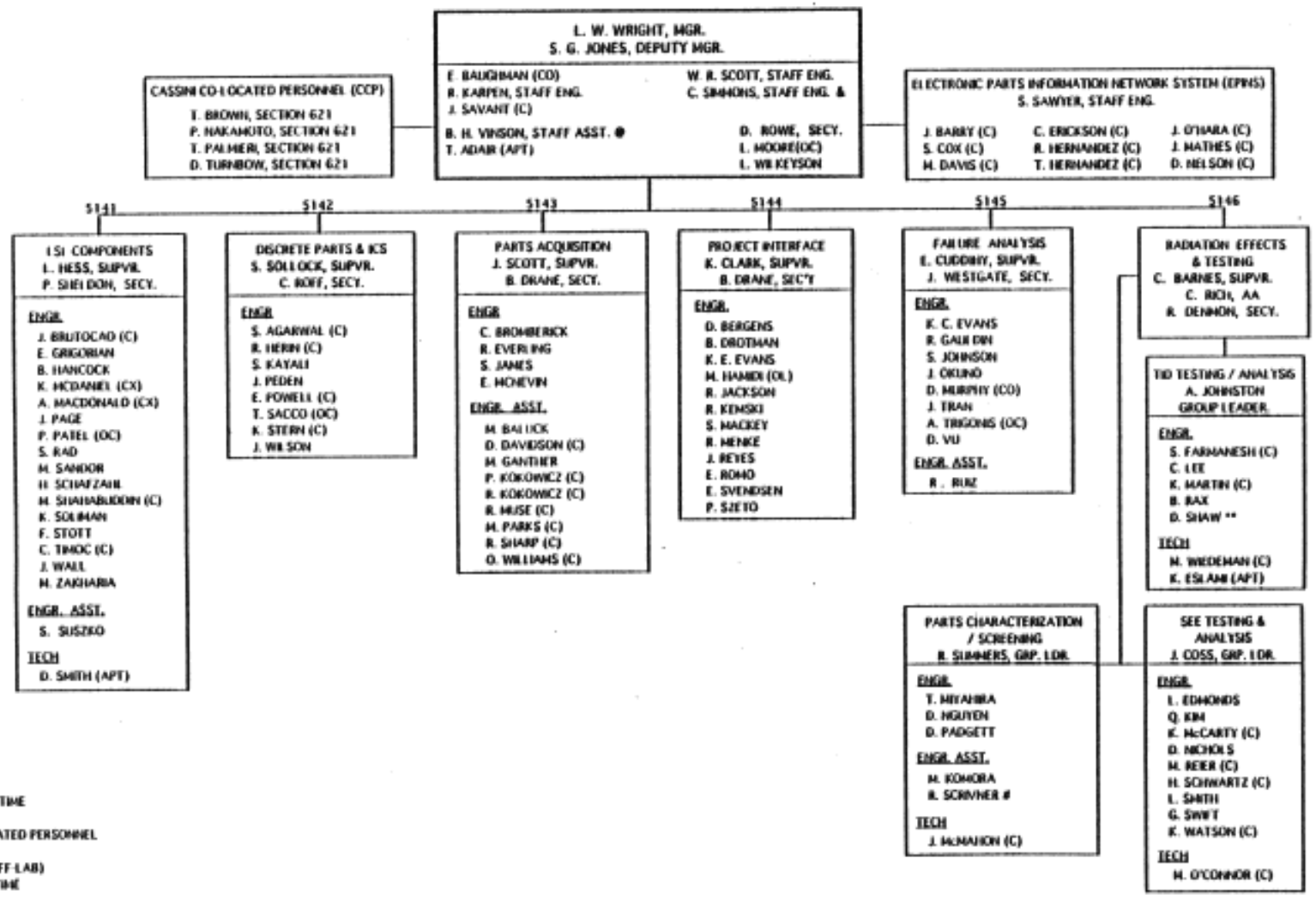
Section 514 is part of the Hardware Assurance Division, which is part of the Office of Engineering and Review (OER). The relationship of the Section to the Laboratory is shown in Figure 2.4. The current Section organization chart is shown in Figure 2.5. A more comprehensive chart indicating the principal functions of each group in the Section is given in Section 6 of this document. The personnel associated with the implementation of EPINS, the Alert / Concerns System and certain personnel, financial, and facility functions are part of the Section Manager's staff.

OER ORGANIZATION CHART



ELECTRONIC PARTS RELIABILITY

SECTION ORGANIZATION CHART



APT = ACADEMIC PART TIME
C = CONTRACTOR
CCP = CASSINI CO-LOCATED PERSONNEL
CO = CONSULTANT
CX = CONTRACTOR (OFF-LAB)
FPT = FACULTY PART TIME
OC = ON CALL
OL = ON LOAN
@ = DIV. 51 AAP REPRESENTATIVE
& = QIDEP REPRESENTATIVE
# = SAFETY COORDINATOR
** = SXMSEI representative

3.0 ELECTRONIC RELIABILITY REQUIREMENTS

3.1 REQUIREMENTS SOURCE

The reliability requirements imposed on electronic parts are derived from several sources. As shown in Figure 3.1, general sponsor (NASA) requirements have been used along with Jet Propulsion Laboratory Policies and Standard Practices and procedures to derive specific requirements to be imposed on electronic parts. The complete hierarchy of electronic parts requirement documents imposed on electronic parts are given in Appendix A, *Electronic Parts Reliability Section Document Tree.* Also shown in Appendix A is a matrix delineating JPL compliance with the specific NASA electronic parts requirements as given in NHB5300.4 (1F), *EEE Parts Management and Control,* dated July 1989.

3.2 PROGRAM CLAS SIFICATION

The Laboratory requires that all hardware supplied to sponsors use the highest quality electronic parts consistent with the mission payload classification. The specific electronic parts requirements imposed on any flight science instrument or engineering subsystem depends on the payload classification. The classification of payloads was originally documented in the NASA Management Instruction, NMI 8010.1, which defined four classifications (A, B, C, D). Based on these classifications, JPL defined its payload classifications in *Payload Classification Product Assurance Requirements,* JPL Document D-1489. All JPL spacecraft systems and space-flight experiment projects are classified as one of the following:

- Class A - Minimum Risk
  Free flyer spacecraft, inaccessible after launch
- Class B - Risk/Cost Compromise
  Free flyer payload, accessible by shuttle after launch
- Class C - Economically Reflyable or Repeatable
  Attached payload
- Class D - Minimum Single Attempt Cost
  Payload not initially planned to be reflown
- Class E - Reflyable in-atmosphere investigation
  Equipment flown on balloon, aircraft, or sounding rockets

A project classification represents the level of acceptable mission risk for the deliverables and reflects agreement between the sponsor Program Office and JPL on cost versus mission risk tradeoff. It is formally approved by the sponsor Program Manager, the JPL Project Manager, and the appropriate JPL Program Manager or Assistant Laboratory Director (ALD).

3.3 ELECTRONIC PARTS PROGRAM REQUIREMENTS

Electronic parts program requirements are defined, by payload classification, in JPL Document D-5357, *Electronic Parts Program Requirements For Flight Equipment..* D-5357 was prepared by and is maintained by the Section. Project specific electronic parts program requirements, or Parts Program Requirements (PPRs), are written for some projects. PPRs are derived from D-5357. The specifications and procedures referenced in D-5357 and PPRs

LABORATORY PARTS POLICIES AND REQUIREMENTS

- **NASA**
  - NMI 5320.5 — Basic Policy For Electrical, Electronic, and Electro-mechanical (EEE) Parts
  - NHB 5300.4(1F) — EEE Parts Management And Control, Requirements For NASA Space Flight Programs
  - NMI 8010 — Classification Of NASA Payloads

- **JET Propulsion Laboratory**
  - SPI 4-11-6 — Selection Of Electronic Parts
  - POL 4-11 — Reliability And Quality Assurance

- JPL D-5357 — Electronic Parts Program Requirements For Flight Equipment

identify detail requirements for the selection, procurement, and use of electronic parts. Parts Program Plans (PPPs) are also required to be generated. PPPs delineate the plan to implement the requirements contained in the PPRs. Section procedures responding to these requirements are described in Section 4.

D-5357 is composed of an introduction and four appendices each containing the parts program requirements for a particular mission class (class A-D). A list of the topics covered in each appendix is shown in Figure 3.2. A generalized comparison of the requirements contained in D-5357, for both engineering and science subsystems, is given in Figure 3.3a through 3.3f.

3.4 WAIVERS AND EXCEPTIONS

JPL document D-5945, *Standard for Waiver Requests,* defines the requirements and procedures for Category A and Category B Waiver Requests that are generated within JPL. These waiver requests are used to document departures from the requirements of JPL Category A or Category B documents when a deviation is believed to be prudent. They do not apply to sponsor-originated (NASA) documents. For deviations concerning electronic parts, the organization using the part(s) or the Section Part Program Manager (PPM) may initiate the waiver request.

3.4.1 Category A Waivers

Category A Waiver Requests are used for deviations from the requirements of JPL Standards (i.e., D-1489, D-5357, etc.), Program Office Policies and Standards, Project Policies and Plans (if approved by an Assistant Laboratory Director (ALD) or higher authority) or the JPL Administrative manuals. The most common use by the Section is for deviations to D-5357. The person initiating the Category A Waiver Request, JPL Form 1993, is responsible for obtaining the required signatures and forwarding the form to the Engineering Data Management Group (EDMG) for recording and distribution. The initiator provides the distribution list.

Waivers are not used to document all deviations. Waivers are appropriate when a deviation is judged "controversial" or when a Project decides in advance not to comply with certain requirements of D-5357. Waivers are not considered appropriate when a deviation involves non conformance with:

- visual inspection criteria
- an arbitrary requirement (e.g., length of burn-in or life test hours or seal window),
- defects which are 100% screenable and do not determine lot acceptance (e.g., x-ray, gross and fine leak test, etc.)
- defects which are artifacts of tester imperfections (e.g., delta failures when the control units "drift" exactly the same amount and in the same direction as the "failed" part)

Certain deviations from the Parts Program Requirements and Parts Program Plans can be evaluated and documented via other means in lieu of a waiver These can be handled by the following procedures.

3.4.1.1 Technical Direction Memorandum (TDM)

The TDM is used for giving directions to a Contractor (e.g., part manufacturer) when both parties (JPL and Contractor) agree that there is no cost impact. It is a means of implementing a

D-5357 CONTENTS

- Parts Program Requirements (PPR)
- Parts Program Plan (PPP)
- Project Approved Parts List (APL)
  - Standard
  - Nonstandard
- TID / SEE Requirements
- Parts Selection
  - Preliminary parts lists
  - Classification / rating
- Parts Procurement
  - Traceability
  - Serialization
  - Data requirements
  - Failure analysis
  - Radiation (TID / SEE)
- Parts Procurement (Cont'd)
  - Lot acceptance
  - Upgrade testing
  - DPA
- Nonstandard Parts
  - NSPAR / Waivers
  - Screening
  - Lot acceptance testing
  - Upgrade testing
- Application
  - Derating
  - Application rating
  - Data requirements
  - GIDEP Alerts
  - Failure analysis
- System Contractors / Subcontractors

ELECTRONIC PARTS RELIABILITY

D-5357 GENERALIZED COMPARISON

REQUIREMENT	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E
APPLICABILITY	FPO, OSSI, and TAP Science and Engineering Subsystem Flight Payloads	→	→	→	→
MANAGEMENT					
Documentation	Establish Parts Program Plan	→	→	→	→
Reviewed by	Standing Review Board	→			
	MMRs	→	→		
Parts Program Req.	Formal	→	→	Informal	→
Parts Program Plan	Formal	→	→		

ELECTRONIC PARTS RELIABILITY

D-5357 GENERALIZED COMPARISON

REQUIREMENT	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E
PART SELECTION					
APL	Required	Optional			
Standard Parts	Grade 1	Grade 1 (Upgraded Grade 2 Allowed)	Grade 2	Commercial	→
NSPARs (Required for Nonstandard Parts)	→	→	→		
ASICs	Quality Practices per MIL-I-38535 TQM Required	→			
	Acquisition Plan	→	→		
	Design Review	→			
	Product Acceptance Plan	→	→		

ELECTRONIC PARTS RELIABILITY

D-5357 GENERALIZED COMPARISON

REQUIREMENT	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E
PART SELECTION (Continued)					
Custom Hybrids	QML-38510	→	→	Commercial	→
	MIL-STD-1772 (S Level)	→	MIL-STD-1772 (Level B)		
	JPL Survey	→			
	Method 5008	→	→		
	Design Review	→	→		
Preliminary Parts List	PDR, CDR	→	→	→	→
TID / SEE	ZPP-2077-RAD	→	→	→	→

ELECTRONIC PARTS RELIABILITY

D-5357 GENERALIZED COMPARISON

REQUIREMENT	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E
PARTS ACQUISITION	Classify Parts	→	→		
	Quality Rating	→	→		
	Application Rating	→	→		
	Serialization	→			
	Data and Review	→	→		
	Failure Analysis	→	→		
	Radiation Lot Test	→	→		
	Source Inspection	→			
	Screening	→	→		
	Lot Acceptance Testing	→			
	Selected DPA	→	→		
	Part Derating	→	→	→	
	ESD Control	→	→		

ELECTRONIC PARTS RELIABILITY

D-5357 GENERALIZED COMPARISON

REQUIREMENT	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E
PARTS ACQUISITION (Continued)	Alert review and Resolution	→	→	Safety Alerts Only	→
	Failure Analysis After 1st Application of Power	→	→		
	As-Built Parts List	→	→		
CONTRACTORS	Parts Program Plan	→	→		
	Requirements Flow-Down	→	→	→	→
	Monthly Reporting	→	→	→	→

ELECTRONIC PARTS RELIABILITY

D-5357 GENERALIZED COMPARISON

REQUIREMENT	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E
HAZARD ANALYSIS			If Failure of Electrical Circuits Could Endanger Personnel, Parts Should Meet Class B Payload Requirements	→	→

change or clarification initiated by JPL, accepting a deviation requested by the Contractor, or indicating acceptance / rejection of items requiring JPL approval. If the cognizant JPL agencies (e.g., Part Specialists, Cognizant Engineer, QA, Failure Analyst, etc.) concurs with the deviation, no further action is necessary.

3.4.1.2 Non-Conforming Material Report (NCMR)

The NCMR is initiated by QA when an electronic part or group of parts fails to meet a specified requirement. The cognizant JPL agencies must agree on a disposition and document the rationale for the decision. QA document QA11.11, *EPQA Receiving / Kitting Activities,* contains the procedures for NCMR disposition.

3.4.1.3 Material Review Board (MRB)

If agreement cannot be reached on technical issues in the TDM or NCMR, the matter can be submitted to MRB. If the MRB fails to reach agreement, a waiver must be initiated in order to use the parts for flight.

3.4.2 Category A Exceptions

An agreement was made between the Flight Projects Office, the Office of Space Science and Instruments, the Office of Technology and Applications Programs, and the Office of Engineering and Review in October 1990 that the wording in JPL D-5945 regarding Category A Waivers will be changed to Category A Exceptions for these Offices. The original issue of D-5945, dated 11-21-90, has not been revised to comply with this agreement. Never-the-less, it is understood that the Category A Exceptions form should be used in place of Form 1993 for these Offices.

3.4.3 Category B Waivers

Category B Waiver Requests, Form 1994, are used for deviations from the requirements of Project, Task, or Program Operating Plan (POP), previously RTOP, documents not approved by an ALD or higher authority. Typical uses by the Section are for deviations from Project Part Requirements documents and design item requirements. Individual part specifications and Destructive Physical Analysis procedures are examples of design item requirements. The procedures for initiating and processing Category B Waivers are contained in document JPL D-5945.

3.5 REQUIREMENTS CONFORMANCE

A Conformance matrix is created for each electronic parts program that has a Parts Program Requirements document. The matrix compares the actual parts program implementation to the project's written requirements.

4.0 ELECTRONIC PARTS PROGRAM DESCRIPTION

4.1 PREPROJECT SUPPORT ACTIVITIES

A number of activities occur in the Preproject phase of a Project, primarily related to classifying hardware, establishing requirements, estimating parts program costs, and planning for the qualification of new and/or unique parts. For the purposes of this document, the "Preproject" phase of a Project is defined to begin sometime after conception of the Project (Phase A/B) and continues until sometime near the "Project Start" (usually Phase C/D initiation).

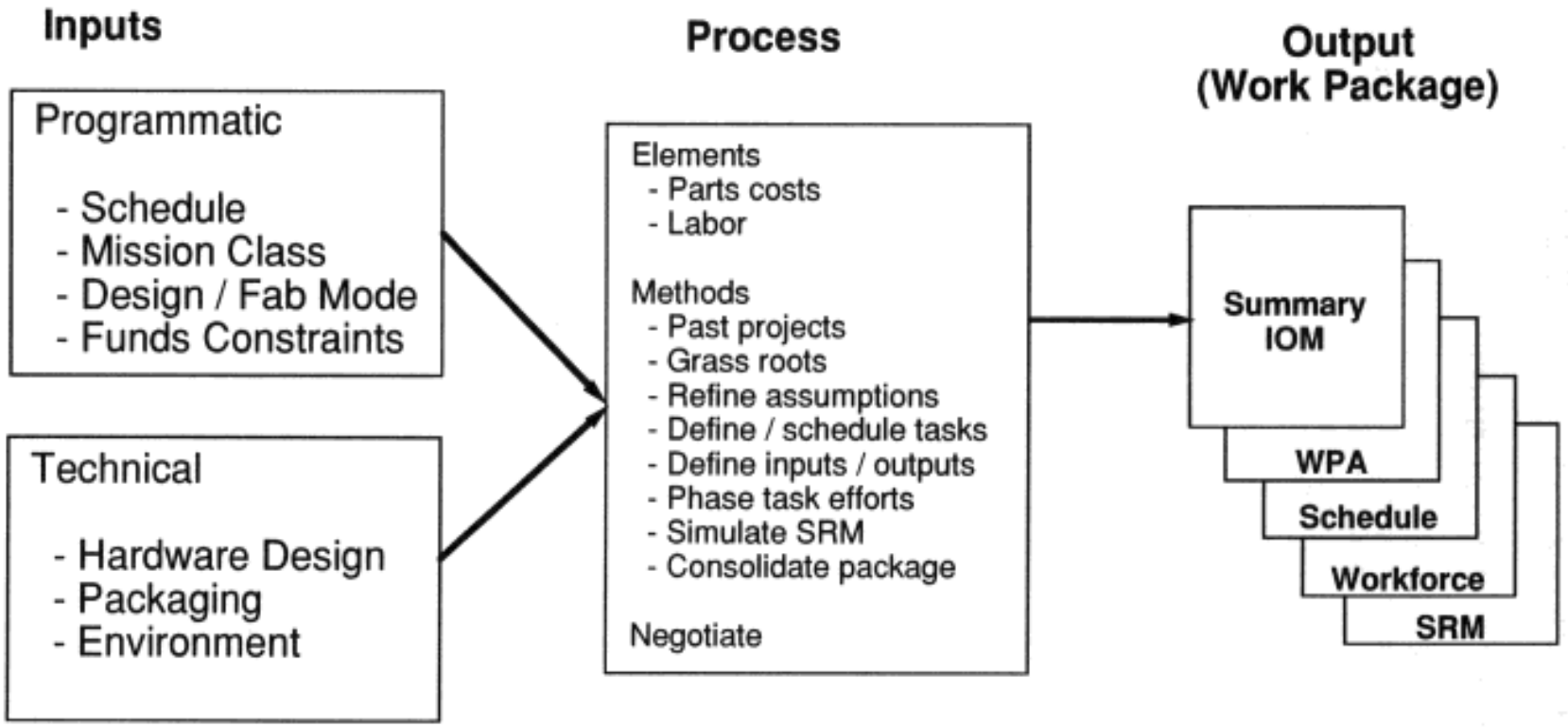
The primary emphasis in the Preproject phase is defining the parts program requirements, identifying the baseline parts and/or parts technology to be used, and developing the preliminary cost estimate.

4.1.1 Parts Program Definition / Budget Development

The information listed below is requested from each project to define the parts program and develop the budget. The completeness of the information contributes to the accuracy of the resulting estimate. This definition process is illustrated in Figure 4.1.

- Project Schedule and Milestones (including, start date, PDR, CDR, fabrication cycle, integration and test cycle, delivery and launch)
- Mission Class
- Project Staff Organization (chart and list of Cognizant Engineers and their subsystems)
- Design / Fabrication Mode (In-house, system contractor, subsystem contractor)
  a) Define for system contractor mode:
     - level of Section 514 involvement required at system contractor (i.e., audit, review, etc.)
     - whether parts are to be purchased by the contractor or JPL.
  b) Definition of relationship to any foreign partners
- System Function and Complexity
  a) Definition of complexity and size of system in terms of existing or planned systems (e.g., 2 times GLL, 1/2 of MO, etc.).
  b) Description of instrument and subsystem functions.
  c) Description of support required of science instruments including non-JPL built instruments and including whether parts are to be furnished by JPL.
- Hardware Complexity
  a) Block diagram.
  b) Number of assemblies to be built, including flight spares.
  c) Discussion / rough cut at parts lists.

PARTS PROGRAM BUDGETS



Significant characteristics of parts program costs:

- Significant fraction of total development cost
- Heavily weighted towards the beginning of the project

d) To what extent engineering units must be the same form, fit, and function as flight units (i.e., same package type and lead configuration).

e) Whether there are any inherited subsystems or designs for which new parts may need to be procured or parts requalified. Also list the degree of inheritance.

7) Parts Requirements

a) Identification of any project unique parts requirements not included in D-5357 (i.e., radiation requirements, etc.).

b) List of any exceptions to D-5357 that are planned.

c) List of any known special or unique parts (i.e., ASTCs, CCDs, Hybrids, etc.).

d) Description of any parts or packaging requirements that may require new technology development of or significant evaluation effort to characterize or qualify.

e) List of any operating or special test requirements that may preclude a common buy of parts for more than one project.

8) Funding Constraints

- Total cap.
- Cap per fiscal year.

A more comprehensive description of the specific process of preparing the budget estimate for a project is contained in Section 7.0 (Volume 2). The results of the budgeting process are summarized in a Work Package Agreement (WPA), which is approved by the Section Manager and submitted to the sponsor.

4.1.2 Baseline Parts Definition

Often Projects will designate a particular part, part type part family or part technology as central to design of the flight hardware. These are considered the project's "baseline" parts / part technology (Figure 4.2). For example, the 54HCXXX family has been designated by the Cassini Project as the baseline family of digital parts. If required, some funds may be used in the Pre-Project Phase to provide a complete evaluation of the parts to ensure preparedness for the project Technology Readiness Review.

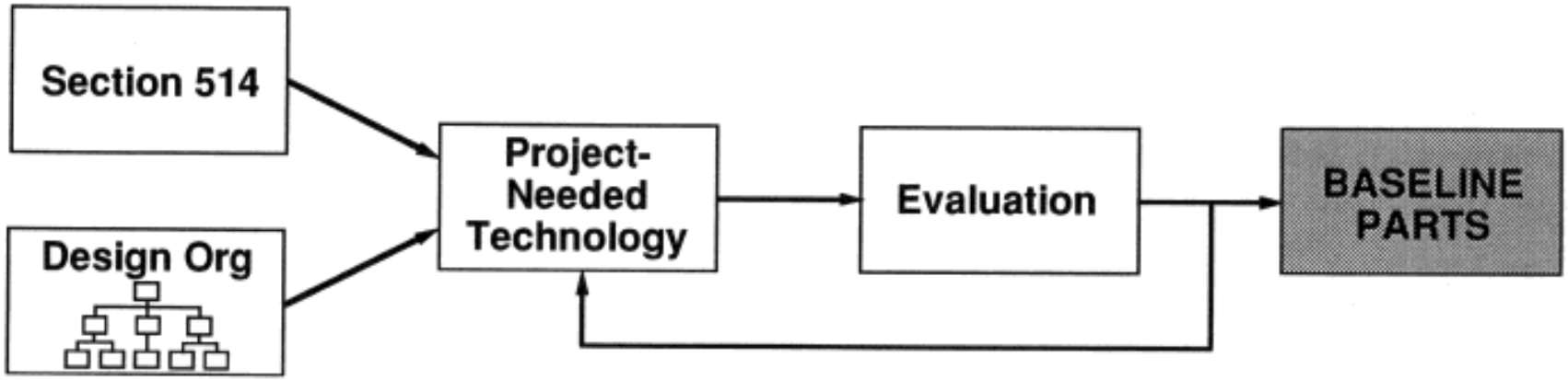
4.2 EARLY PROJECT SUPPORT ACTIVITIES

The initial emphasis in early project phase is the definition of the parts program requirements, further development of the parts program cost estimate, and planning for the timely procurement of flight quality parts. It is of paramount importance to obtain sufficient funding for these activities early in the Project life cycle in order to have time for long lead procurements and avoid sacrificing part reliability by using lower quality parts in order to make delivery milestones.

4.2.1 Project Parts Program Requirements (PPR) Document

The first electronic parts requirements document which is created for a project is the Parts

BASELINE PARTS



Definition

Parts, part types, or part families determined to be central to the design of the flight hardware

Selection Process

- Section 514 and Design Organizations identify via informal process or PSC
- Integral input for Technology Readiness Review
- Project funds evaluation
- Outputs form baseline parts to APL

Program Requirements (PPR). This document consists of the appropriate appendix of JPL D-5357 plus known Project-unique requirements (e.g., TID, SEE, sparing, hardware classification, common/anticipatory buy approach, inheritance philosophy). JPL D-5357 establishes the basic Institutional Parts Program Requirements for Flight Equipment. Each project then establishes its own set of requirements which are derived from and should be consistent with these Institutional requirements. Consistency is assured by using the appropriate appendix of JPL D-5357 as the main body of the PPR. Deviations from JPL D-5357 requirements are accommodated using Category A waivers. Project-unique requirements beyond JPL D-5357 requirements should be documented in the main body of the PPR. The PPR is then approved by the Manager of the JPL Electronic Parts Reliability Section, the JPL Project Product Assurance Manager (PAM) and the JPL Project Manager (PM).

4.2.2 Project Parts Program Plan (PPP)

Each organization responsible for implementing a parts program is required to write a Parts Program Plan (PPP). The PPP documents how the implementation of the PPR will be accomplished. The PPR indicates what is to be done; and the PPP indicates how it (PPR) will be accomplished. The PPP should indicate what hardware is affected, the overall parts organization that will implement the parts program, the implementation plan and procedures for satisfying each PPR requirement (indicating flow down to subcontractors) and how all of this will be reported to JPL. JPL Section 514 will always write a PPP since, at a minimum, 514 will have to review contractor's NSPARs, specifications, waivers, etc. The relationship between D-5357, the PPP, and the PPR is shown in Figure 4.3.

4.2.3 Contractor Parts Program Requirements

One of the more important activities accomplished in the early phase of a project is the selection of contractors and/or subcontractors to design and/or fabricate flight hardware. This implies that a contractor will be implementing a parts program. To ensure that the contractor's parts program meets the JPL Project PPR, inputs must be provided by the Section to the Request For Proposal (RFP) and the contractor's PPP and internal parts program procedure must be evaluated. Contractor PPPs should be written within two months of Contract award.

It is absolutely imperative that all of the parts program requirements be integrated into the RFP: this is the first opportunity to impose the requirements, and all future changes result in significantly higher costs and schedule impacts (if changes can be made at all). Typically, the Project develops an RFP and solicits inputs from Product Assurance (including Section 514). Sometimes, however, Section 514 gets involved after the RFP has already been assembled, and the Section functions in a review mode. In either case, it is required that the following things are included in the RFP:

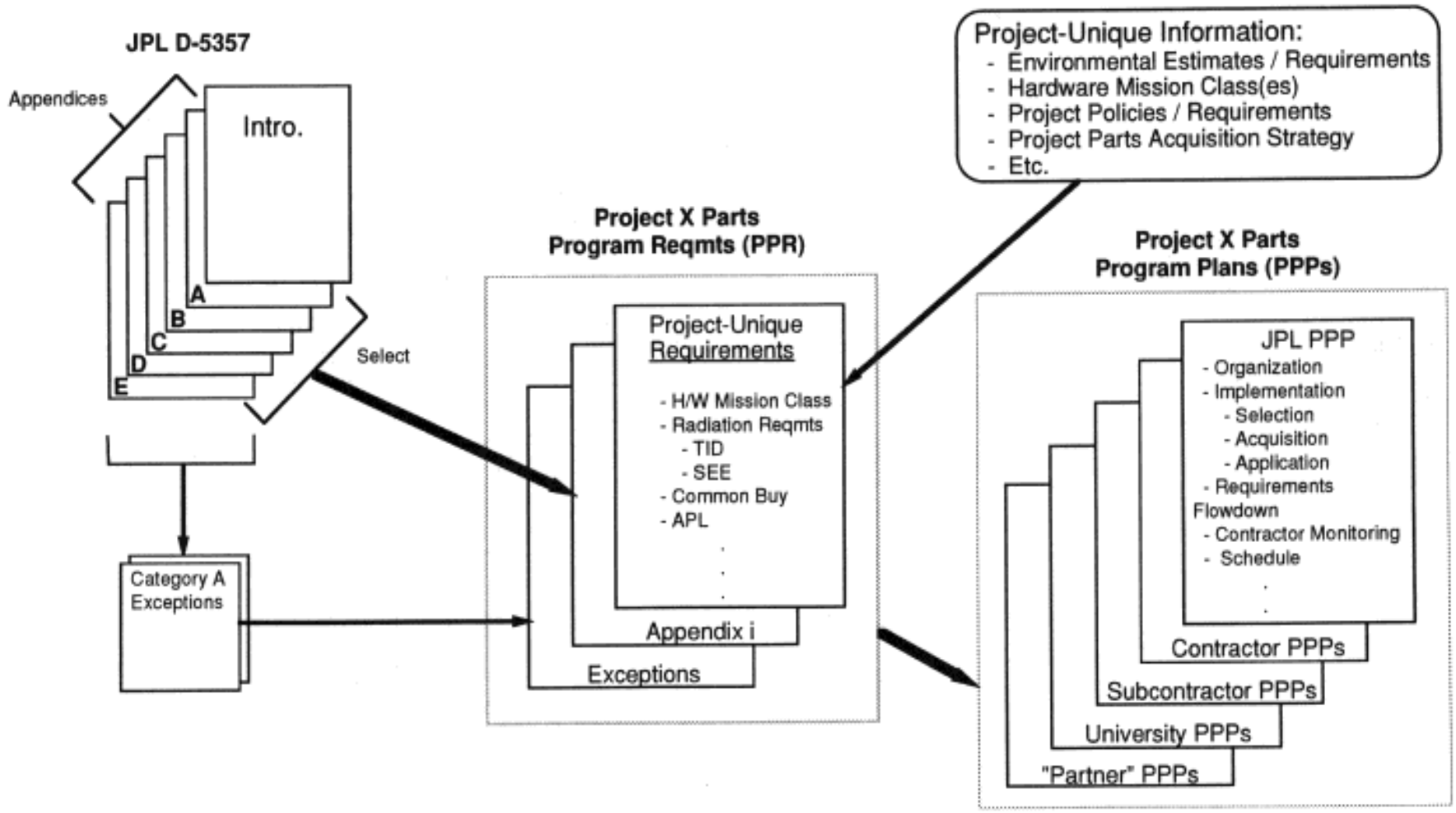
1) Contractual linkage to JPL D-1489 and PPR (or JPL D-5357)

   This linkage is usually established by making these applicable documents or exhibits to the RFP and eventual contract. This is often done in a specimen contract and/or as a Statement of Work (SOW) item.

2) Statement of Work (SOW)

   As stated above, quite often the SOW contains a direct linkage of exhibits and the contract. Also, parts requirements can be scattered throughout the SOW (e.g., spares, new technology qualification). The entire SOW needs to be reviewed to ensure compatibility with the PPR.

REQUIREMENTS & PLANS



3) Data Requirement Descriptions (DRDs) (also referred to in some RFPs as Data Item Descriptions (DIDs)

Typically, there must be at least two Parts Program DRDs: the Parts Program Plan (PPP) and Parts Data. Many times these are combined with Materials and Processes. In addition to these directly applicable DRDs, other DRDs may indirectly specify parts program related information. These can include a DRD for the End-Item Data Package and Problem-Failure Reports. In the End-Item Data Package, it is imperative that the As-built data for all flight hardware contain sufficient part related information, and that the End-Item Data Package include:

- NSPARs (including related specifications - e. g., procurement, screening, lot acceptance, additional testing, upgrading, radiation lot acceptance test plans)
- Failure analysis and destructive physical analysis (DPA) reports
- Total Dose Radiation and single event effects parts capability analysis reports
- Parts procurement schedules and status
- Preliminary Parts Lists
- Final As-designed Parts List
- As-built Parts Lists
- Waiver Request for EKE Parts

It is important to ensure that adequate time is provide for the performance of the Section 514 reviews of contractor required submittals. Typically, six (6) weeks are required to ensure that the reviews can be accommodated within the normal Section work flow.

4.3 PARTS SELECTION

The part selection process is designed to maximize:

- the reliability of flight hardware within cost constraints and
- the efficiency of the design and acquisition processes

by encouraging the use of a limited number of part types. The selection requirements for the four JPL Mission Classes are described in paragraph 5.0 of the respective appendix of JPL D-5357. Additional information on the selection process is contained in section 3.3 and 3.4 of JPL 51-G-01, *Parts Specialists Guidelines.* This section is intended to summarize and clarify the selection process used within the Section.

4.3.1 Selection Sources

Selection source lists generally grade or prioritize parts (e.g., standard parts, non-standard parts and standard part candidates for a given mission class or (in MIL-STD-975) Grade). The term "standard part" has several meanings, depending on which document is used: MIL-STD-975, JPL D-5357, or a specific project's Approved Parts List (APL). Figure 4.4 shows how the

various source lists are related. The relationship between the various "Standard" and "Nonstandard" parts on the various lists is also shown. The hierarchy of the various electronic parts selection source lists required to be used for JPL projects are delineated in Figure 4.5.

4.3.1.1 NASA Standard Parts

The NASA Standard Parts List, MIL-STD-975, is the list of electronic parts that have been:

- nominated by NASA Centers, and
- evaluated, selected, and approved by NASA Parts Program Office (NPPO)

In general, it consists of the following:

- Grade 1 parts; e.g., MIL-M-38510 Class S microcircuits, MIL-S-19500 JAN S semiconductors, and the highest available grade of certain Established Reliability (ER) passive parts, etc. (e.g., S failure rate level for capacitors and resistors).

- Grade 2 parts; e.g., MIL-M-38510 Class B microcircuits, MIL-S- 19500 JAN TXV semiconductors, and the second highest available grade of ER passive parts, etc. (e.g., P failure rate level for capacitors and resistors).

4.3.1.2 Institutional Parts List (IPL) Standard Parts

The Section has initiated the generation, per the recommendations of the EPSC, of an Institutional Parts List as a replacement for the older Preferred Parts List. The IPL is a compilation of all the electronic parts that JPL deems acceptable (in accordance with D-5357) and procurable for flight use. The IPL is part of the Electronic Parts Information Network System (EPINS) computer system. The IPL currently consists only of the *NASA Standard Parts List* (MIL-STD-975). However, it is being expanded as additional data and resources become available. It does not address Project unique requirements such as SEE and total dose radiation levels.

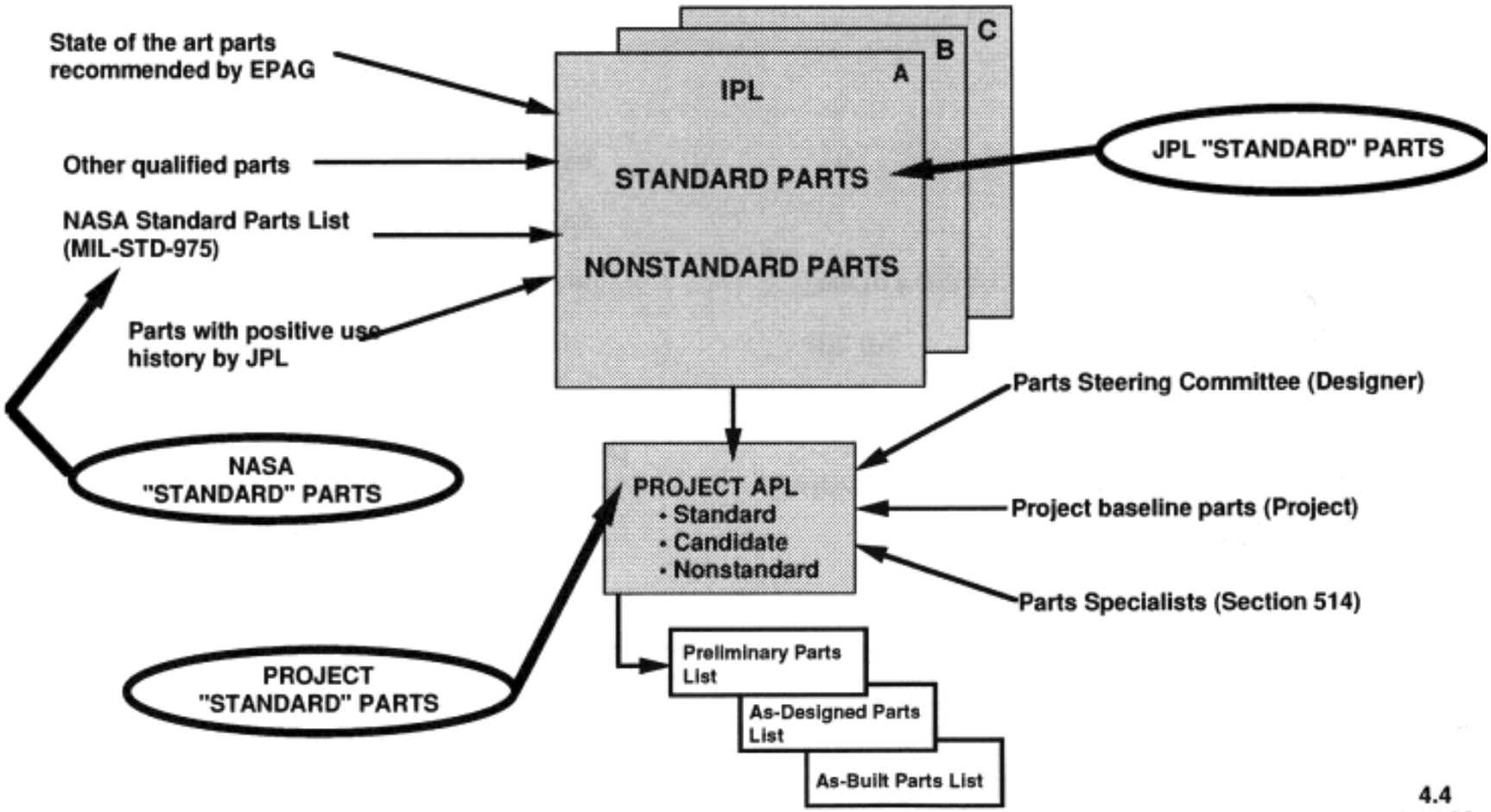
4.3.1.3 Project Approved Parts List (APL).

The APL is specific to a project and lists parts that have been approved for use on that project. An APL is required for Class A missions and optional for all other mission classes. JPL D-5357 defines the sources from which most APL parts are selected, and the selection process.

The responsibility for preparing a project's APL lies with Section 514 and specifically with the Section's designated Parts Program Manager in conjunction with the cognizant Parts Specialists. The final release of the APL requires approval signatures from the 514 Section Manager, the Project R&QA Manager, and the Project Manager. Although the APL is released as a project document, updates and revisions to the nonstandard parts section are under Section 514 cognizance and therefore not under direct project change control. A simplified APL approval process is shown in Figure 4.6. The definition of "Standard Part", "Nonstandard Part", and "Candidate Standard Part" and their interrelationship are discussed in JPL D-5357. Each APL standard part has been certified as meeting the project's requirements and thus can be used by the designer without having to process a NSPAR.

Ideally, the APL includes the minimum set of parts required to implement the design and to assure commonality and cost efficiency.. Again, ideally, all the parts on the APL should have extensive histories of successful use on space programs so that the potential for technical

INSTITUTIONAL PARTS LIST - IPL
(REPLACEMENT FOR PREFERRED PARTS LIST - PPL)



ORDER OF SELECTION PREFERENCE

MISSION CLASS A/B

Selection Source	Section	NSPAR Needed
Project APL*	Standard	No
Project APL*	Candidate	No
JPL IPL	Standard	Yes
Project APL*	Nonstd.	Yes
JPL IPL	Nonstd.	Yes
Talk to Parts Specialist		

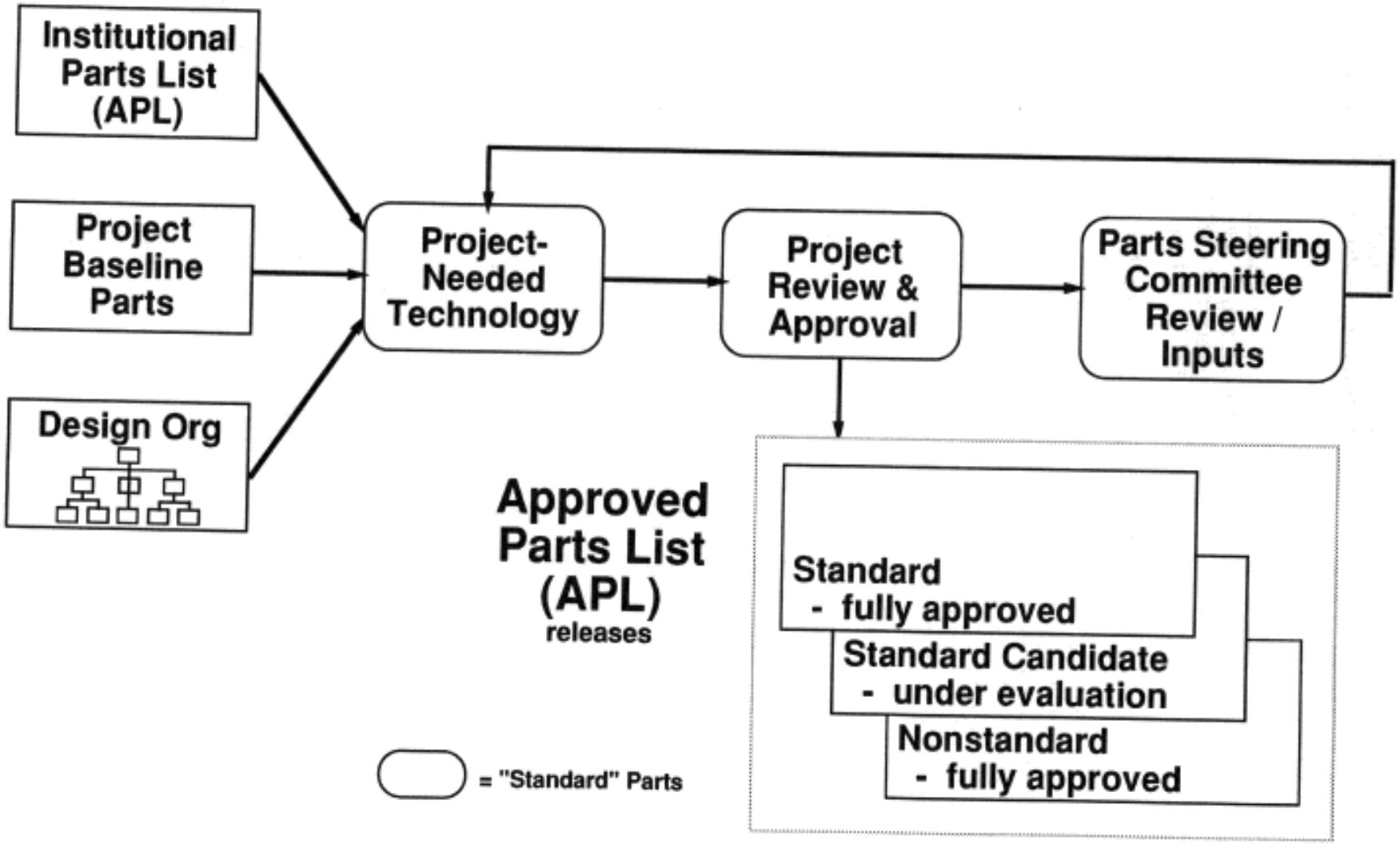
MISSION CLASS C

Selection Source	Section	NSPAR Needed
JPL IPL	Standard	No
JPL IPL	Nonstd.	Yes
Talk to Parts Specialist		

- Dropping down on the list generally incurs higher cost, longer deliveries and higher risk.

* Mission Class B may not have an APL.

APPROVED PARTS LIST (APL) PROCESS



problems or lot related failures is minimized. The Section, the design agency and the Project Office work together to define an APL which approximates these ideals as closely as possible.

4.3.2 Selection and Approval Process

The iterative parts selection process (recommendations, reviews of parts lists, NSPAR and Waiver processing) is illustrated in Figure 4.7 herein. This selection process is summarized, for each mission class, in the appropriate appendix of D-5357. Additional information on the process is also found in paragraph 3.5 of 54-G-01, *Part Specialists Guidelines.*

4.3.2.1 Residual Parts and Parts From Inherited Designs

JPL D-5357 describes the requirements for the use of residual parts for flight hardware. The inheritance review for electronic parts must be addressed on three levels, depending on the state of the design and hardware construction. For parts already built into flight hardware, an inheritance review is performed to identify reliability risks or radiation susceptible items. Where only the design is inherited (the hardware build has not started), the inheritance review will help reduce risk. When only the parts are inherited, their pedigree can be reviewed to determine appropriate use. Guidelines are contained in 51-A-05, *Inheritance Review Guidelines.*

4.3.2.2 ASICs and Hybrids

D-5357 defines the process and requirements for use of ASICs and custom hybrids.

4.3.2.3 Radiation Considerations

D-5357 defines the requirements for ensuring that parts meet the project PPR requirements. It should be noted that radiation test samples should be representative of the flight parts being procured. Existing sources of information on TID and SEE (e.g., government agencies, part manufacturers, other users of the part) are utilized to the maximum extent possible. The Section's Radiation Effects Group has the principal responsibility for evaluating parts against PPR radiation requirements and determining need for testing. Other sources of information may be suggested by the Project Parts Interface Group (whose members contact with system contractors may make them aware of testing completed or planned by other users), and the component specialists (LSI or Discrete Parts and ICs Group) and contract technical managers (Parts Acquisition Group) (whose contact with manufacturers may make them aware of testing completed or planned by the manufacturers or other customers).

4.3.2.4 Parts List Review

Document 51-G-01, paragraph 3.5 and Figure 4.8 herein describe the parts list review process. This process identifies parts which are nonstandard as defined by the project PPR or D-5357 and identifies alternates where known.

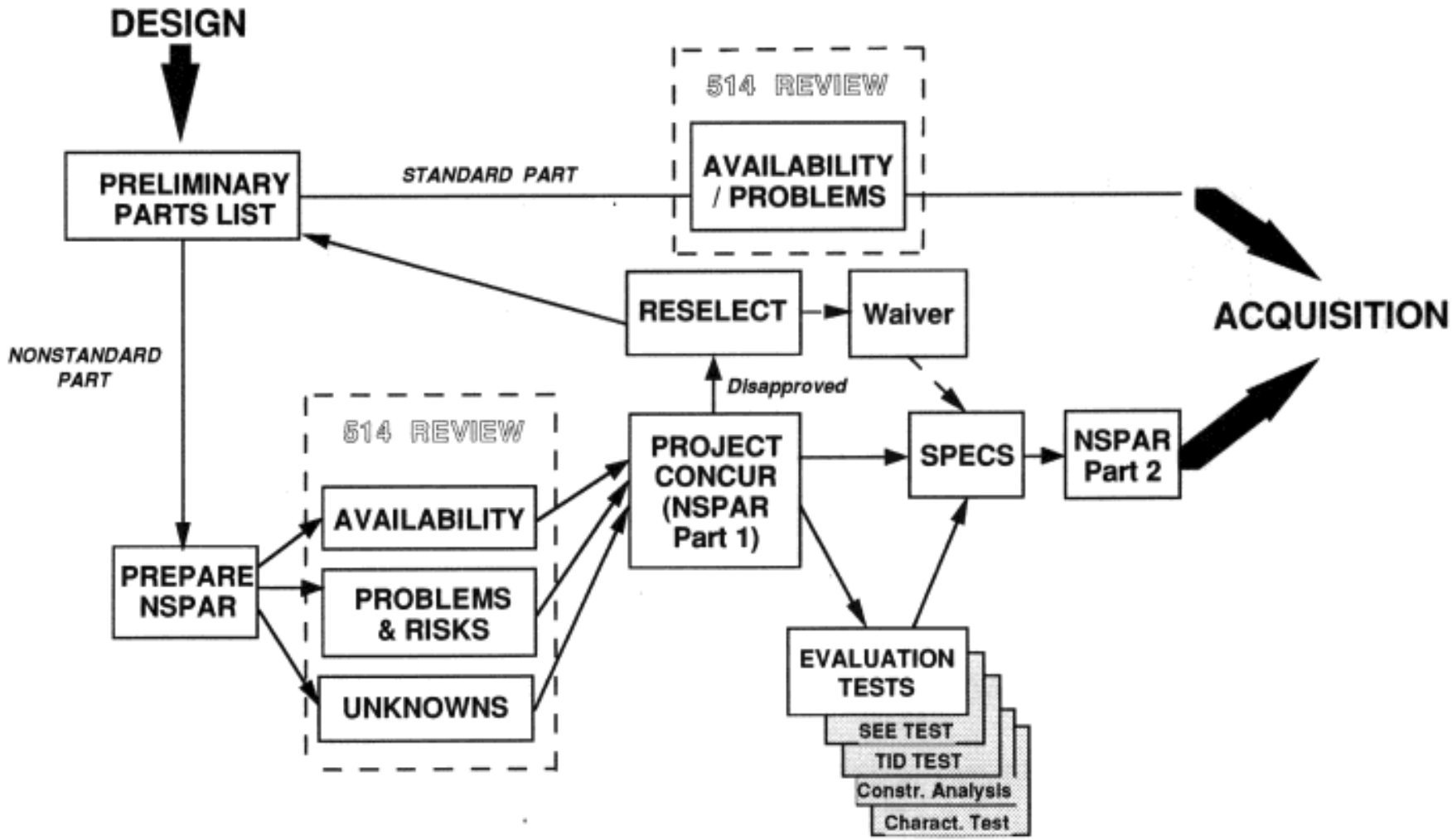
4.3.2.5 Nonstandard Parts Approval Request (NSPAR)

The NSPAR is the primary tool to allow the designers to request approval to use a nonstandard part. The specific purpose is to allow the selection, review, evaluation, authorization and procurement of parts that are nonstandard. It is used to encourage standardization of part type usage (i.e., the Specialist can recommend a standard part as an alternate), to allow the Parts Specialist to identify noncompliance to the Project requirements, and to allow the Project to mitigate the risks of nonstandard part usage through design, test, or other procedural changes.

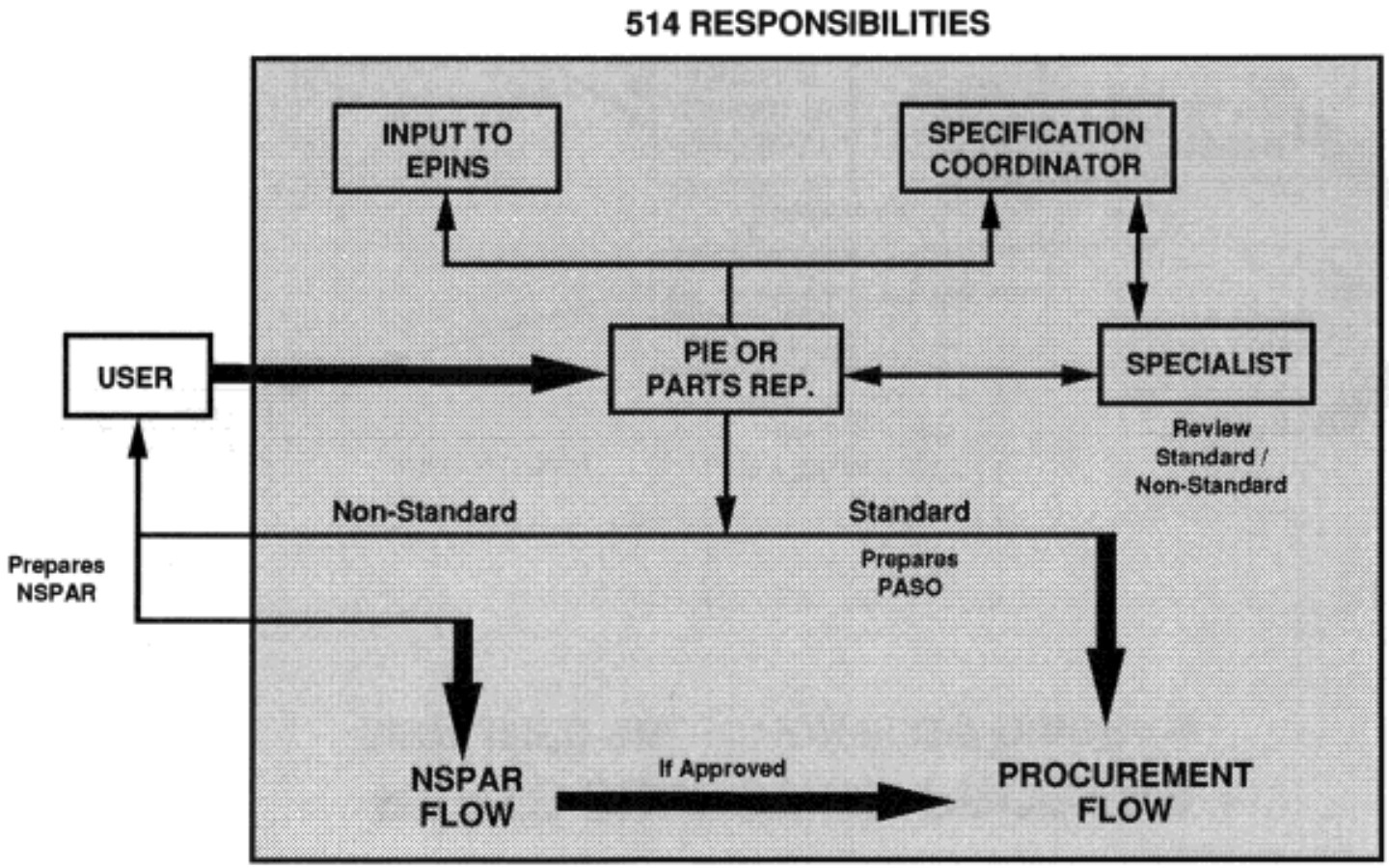
Document D-5357 describes the NSPAR process in general. The detailed procedure for

PARTS SELECTION PROCESS

SIMPLIFIED SELECTION FLOW DIAGRAM



PARTS LIST REVIEW FLOW



the processing of NSPARs by the Section is contained in 51-D-01, *514 NSPAR Procedure.* The Section is also required to review and approve all contractor generated NSPARs. The procedure to be used is the same as that used for in-house generated NSPARs. The specific process flows are shown in Figures 4.9 and 4.10.

4.3.2.5.1 Preparation / Approval

The NSPAR is prepared by the respective hardware designer requesting the use of the part. The Parts Specialist reviews the NSPAR to determine if the requested part is reliable and meets the project requirements. The Parts Specialists will write or review the specification when appropriate. The Radiation Specialist, in parallel with the Parts Specialists' review, reviews the NSPAR to ensure that the part meets the project radiation requirements. The Project Interface Engineer provides the interface for the Section, tracks the NSPAR, and procures the part

The NSPAR is divided into three sections:

Part I (General Concurrence Section) - This establishes the requester's need and initiates the various 514 preliminary reviews. NSPAR Part I review is conducted by the Parts Specialist and Radiation Specialists. The part is reviewed for overall reliability and checked against the PPR. The Project must concur with the NSPAR before the various organizations can proceed with further design activities or Section 514 can proceed with preparation of specifications and the performance of any necessary evaluation tests.

In the event that a part is rated "unacceptable" in Part I by the Specialist (because it does not meet the project requirements, has a history of unreliability, fails the evaluation tests, and/or there is known risk) or as "unacceptable unknown" (because more information is needed), Section 514 will submit all substantiating information and a risk assessment to the Project.

Project approval of Part I is the authorization to prepare procurement specifications and/or conduct the evaluation tests described by the Specialist. Generally Part I is disapproved when use of the part is deemed either too costly or too risky or there is no Section knowledge re the reliability of the part.

Part II (Technical Concurrence) - Part II of the NSPAR identifies the procurement and test specification numbers and an approval by the Parts Specialist indicates that the specifications are acceptable. The part can then be procured.

Disapproval of part II occurs when the specifications do not meet the PPR. Project approval of Part 1 and Section approval of Part II, unless a waiver is obtained, are required prior to the Section proceeding to acquire the part.

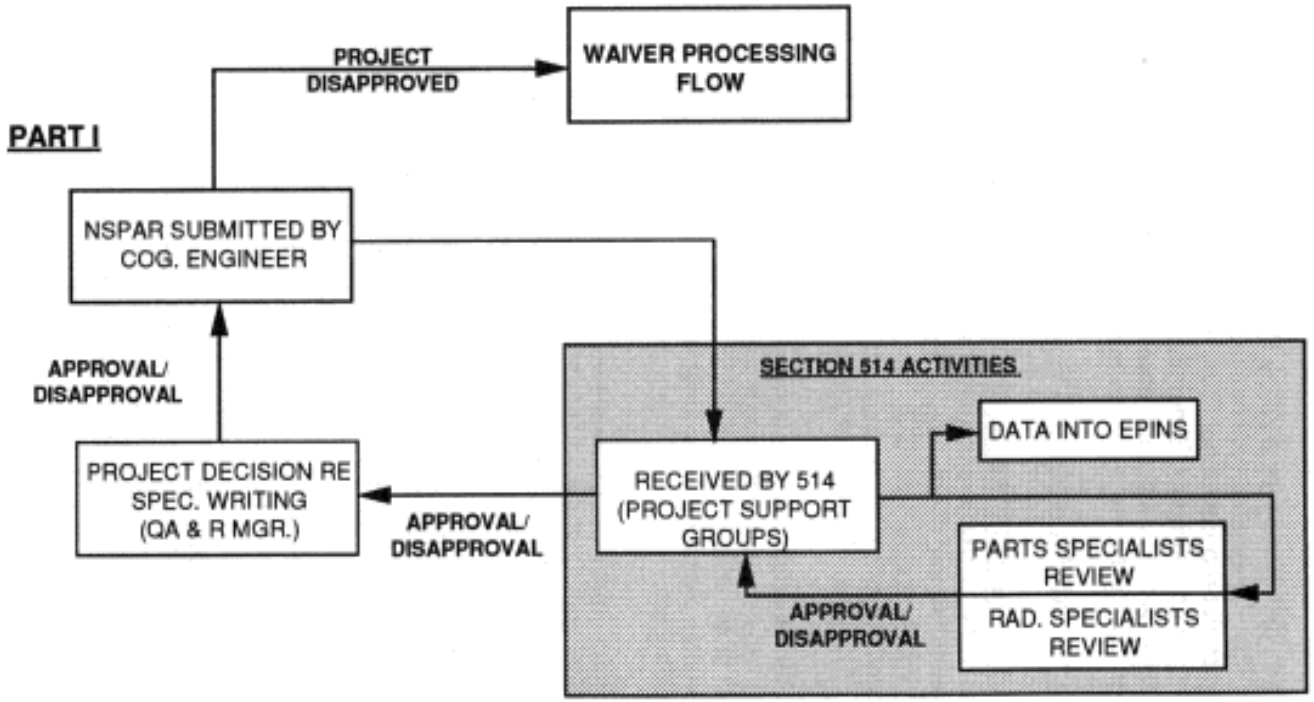
Part III (Compliance) - An approval in Part m of the NSPAR indicates that all of the specified requirements were met and that the parts are flight worthy. Section 512, Quality Assurance (QA) completes this portion of the NSPAR (for JPL in-house generated NSPARs) after the parts are received.

4.3.2.6 Waivers

In the event that the project wishes to use a part for which the NSPAR has been disapproved by the Section, a waiver must be initiated by the Cog. Engineer or user and processed in accordance with JPL D-5945, *Standard for Waiver Requests.* Paragraph 3.8 of 51-G-02 describes the Part Specialist's role in the waiver review process.

NSPAR FLOW

INTERNALLY GENERATED



NSPAR FLOW - (Cont'd)

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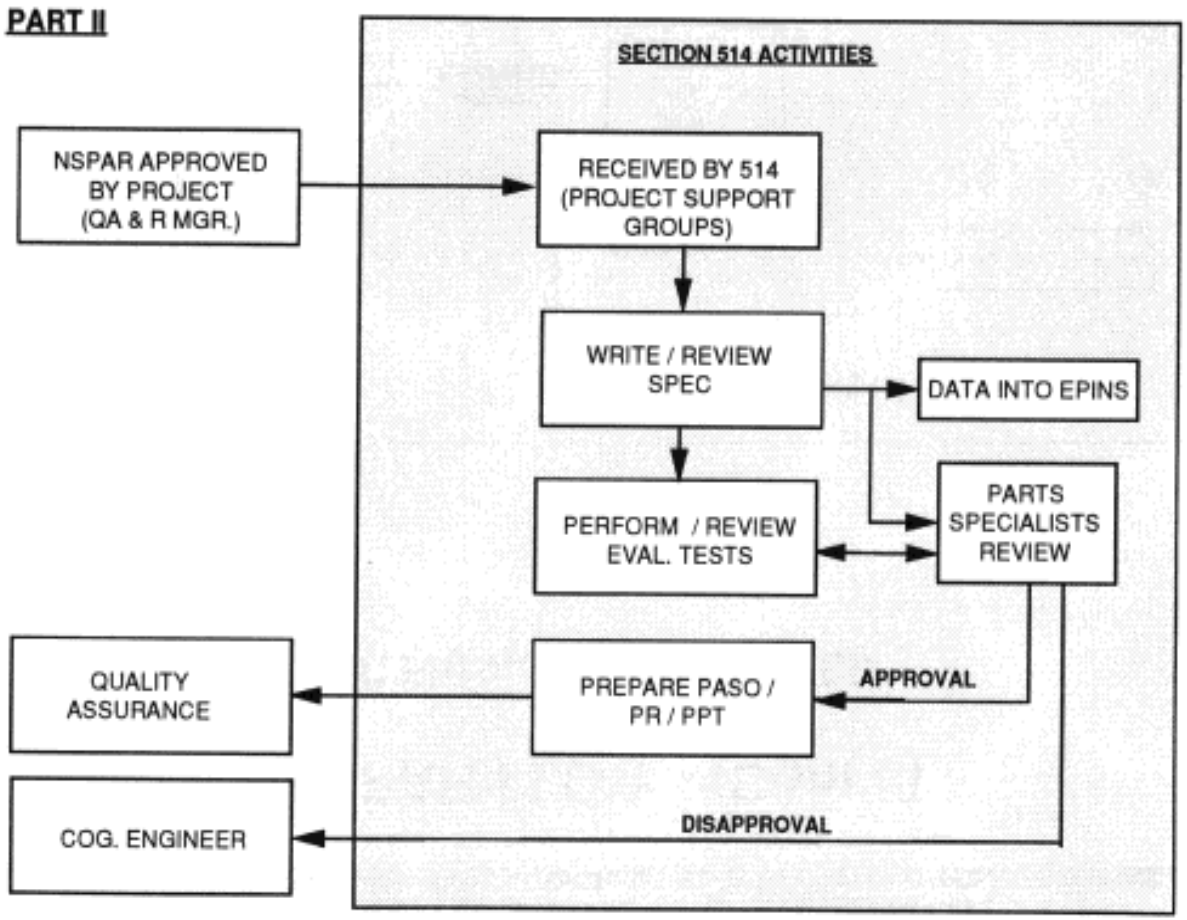

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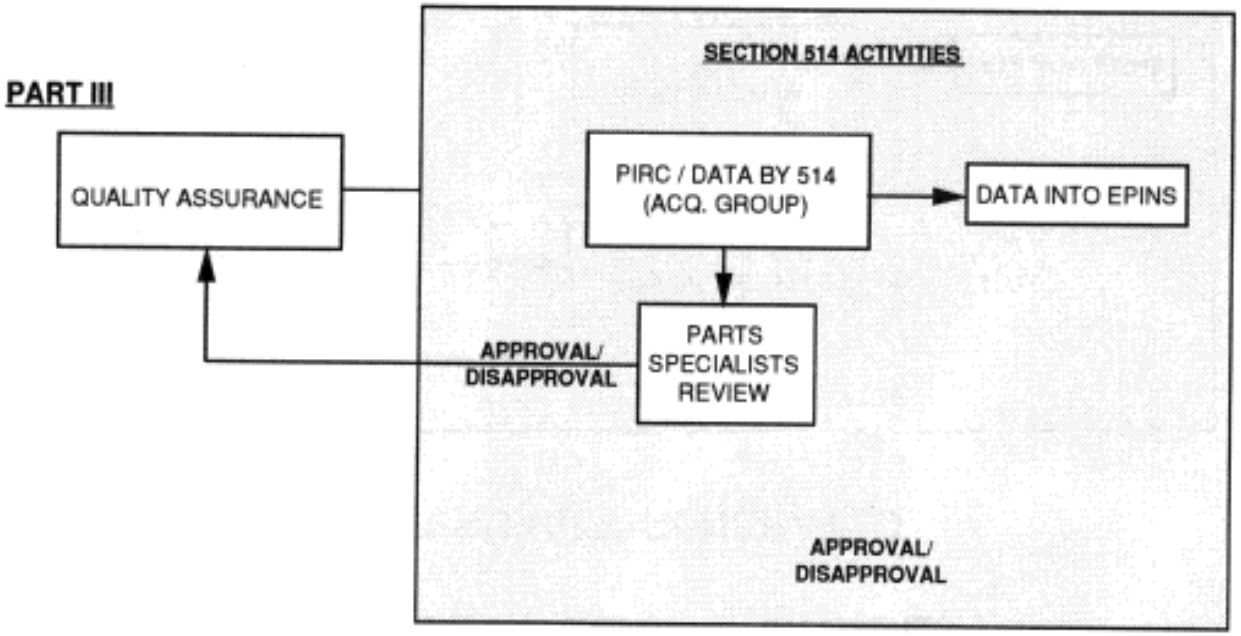

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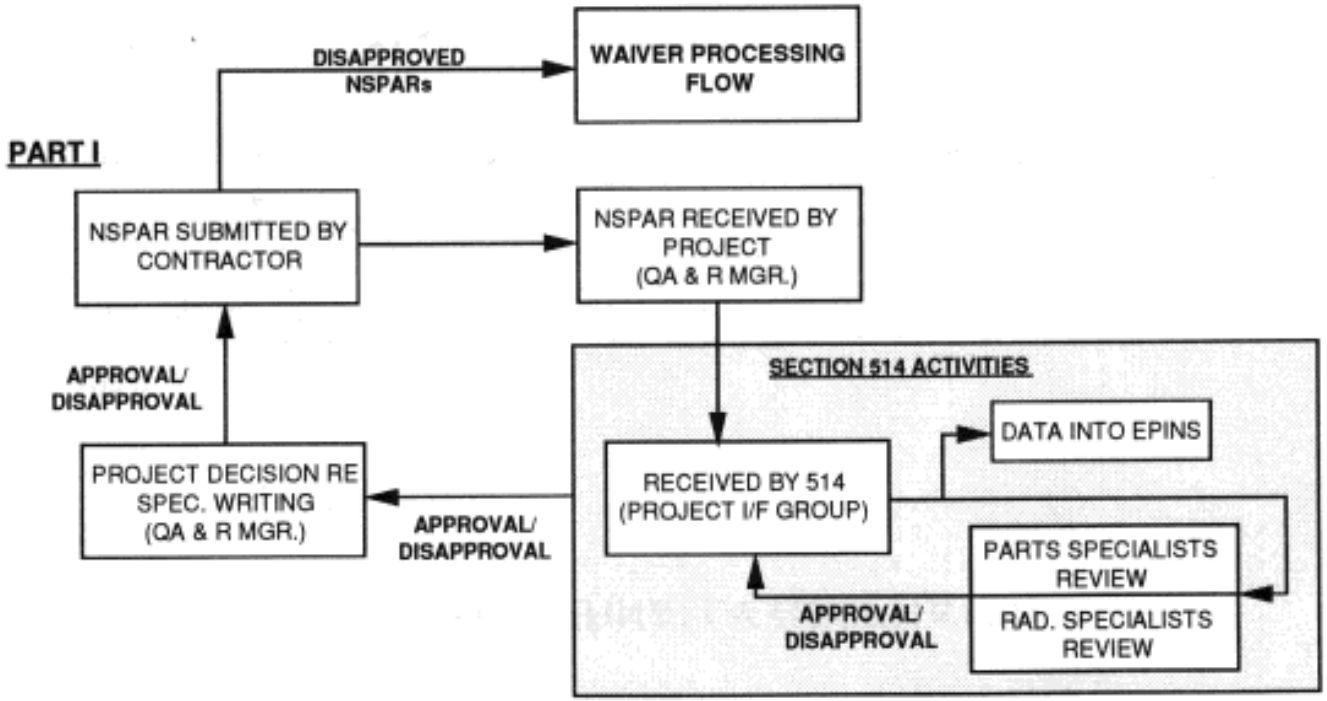

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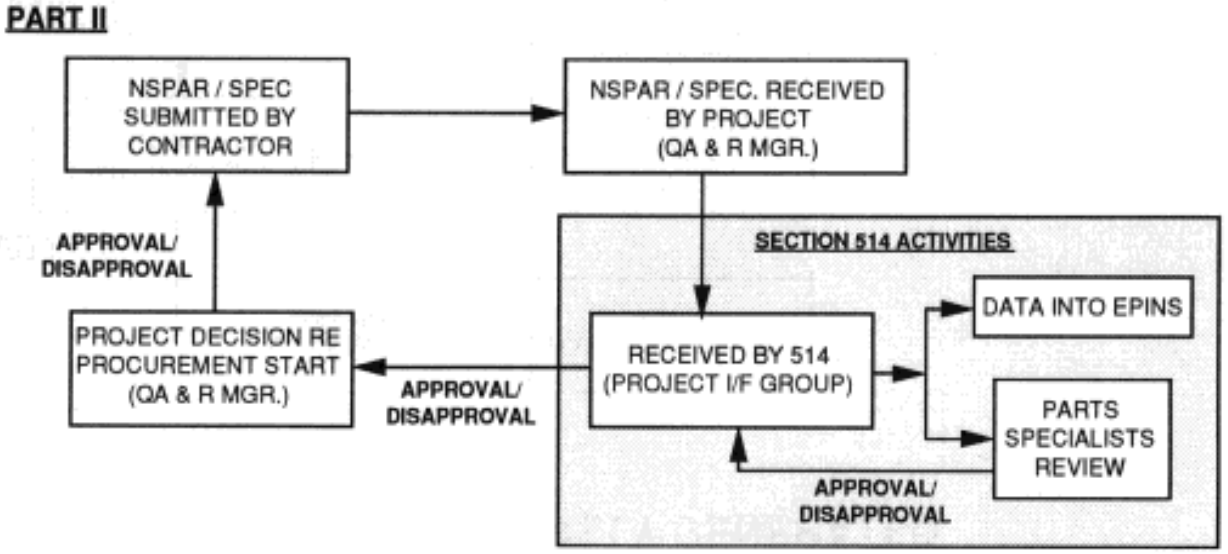

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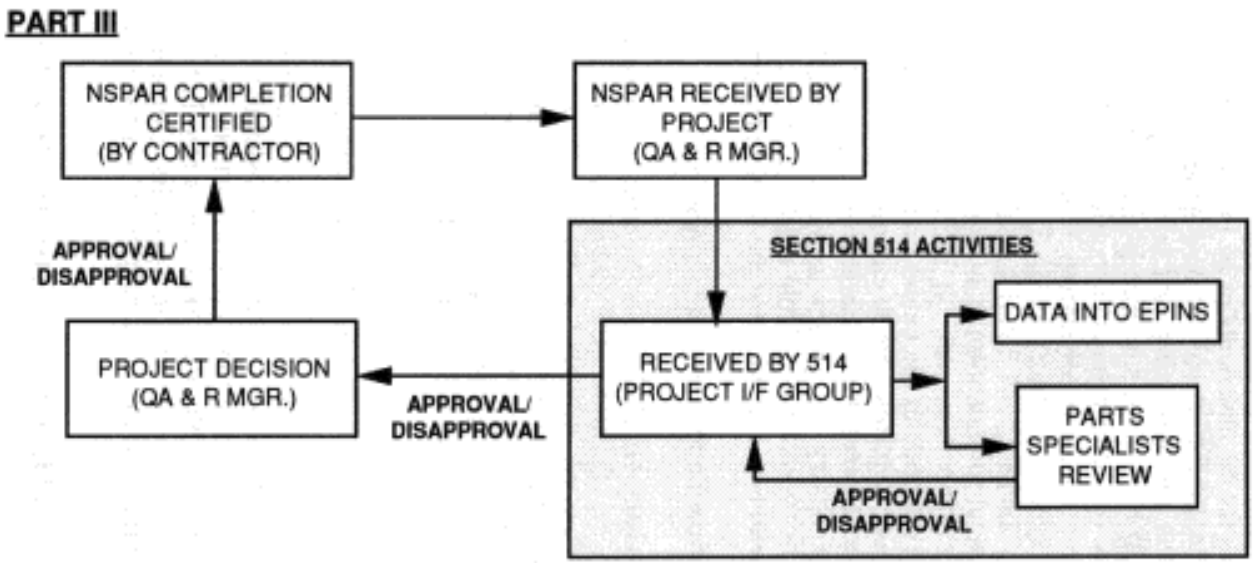


4.3.2.7 Specifications

4.3.2.7.1 General Guidelines

Figure 4.11 delineates the hierarchy of specifications now used by the Section for the acquisition of electronic parts. Described below are the requirements and process used in the generation of the appropriate JPL specifications.

The guidelines for requirements to be included in specifications are given in D-5357 and further defined in the appendices of the new general specification document, ZPP-2073-GEN, *General Specification for Screening and Lot Acceptance Testing of Nonstandard Electrical Parts.* The Section specification structure is similar to the MIL specification structure in that it consists of a general (or procurement) specification ("CS" document) which gives the manufacturing, screening, and lot qualification requirements for a family of parts, plus a detail specification ("ST" type document) which addresses only those requirements specific to the particular part type(s) included. A detail specification ("PT" type document) is used when some other (non "CS") general specification is invoked (e.g., manufacturer's internal flow specification or another customer's specification). It is the Section policy to utilize existing MIL specifications (detail and general) to the extent possible, limited by constraints imposed by D-5357 and the various project requirements documents. When a MIL specification exists but needs modification in order to meet these requirements, the policy is to generate a document which specifies only the necessary exceptions to the MIL specification. Samples and templates or boilerplate for specifications are available on the Section computer network or from the person in charge of specification coordination for the Section (Specification Coordinator).

4.3.2.7.2 Specification Preparation and Approval

Document 51-G-05, *Guidelines for Preparation of Specifications,* describes the process by which JPL general specifications (CS specifications) and detail specifications (ST and PT specifications) are generated, approved, and released. Most recent specifications are available on the EPINS network. Hard copies are available in the Discrete Parts and IC Groups' files. Document 51-D-01, *514 NSPAR Procedure* shows how the review of non-JPL specifications is accomplished as part of the NSPAR process and 51-G-01, paragraph 3.5 describes the role of the Part Specialist in the review process. Figure 4.12 shows the process currently used to generate specifications.

4.3.2.7 Preparation and Approval of Evaluation and Test Plan

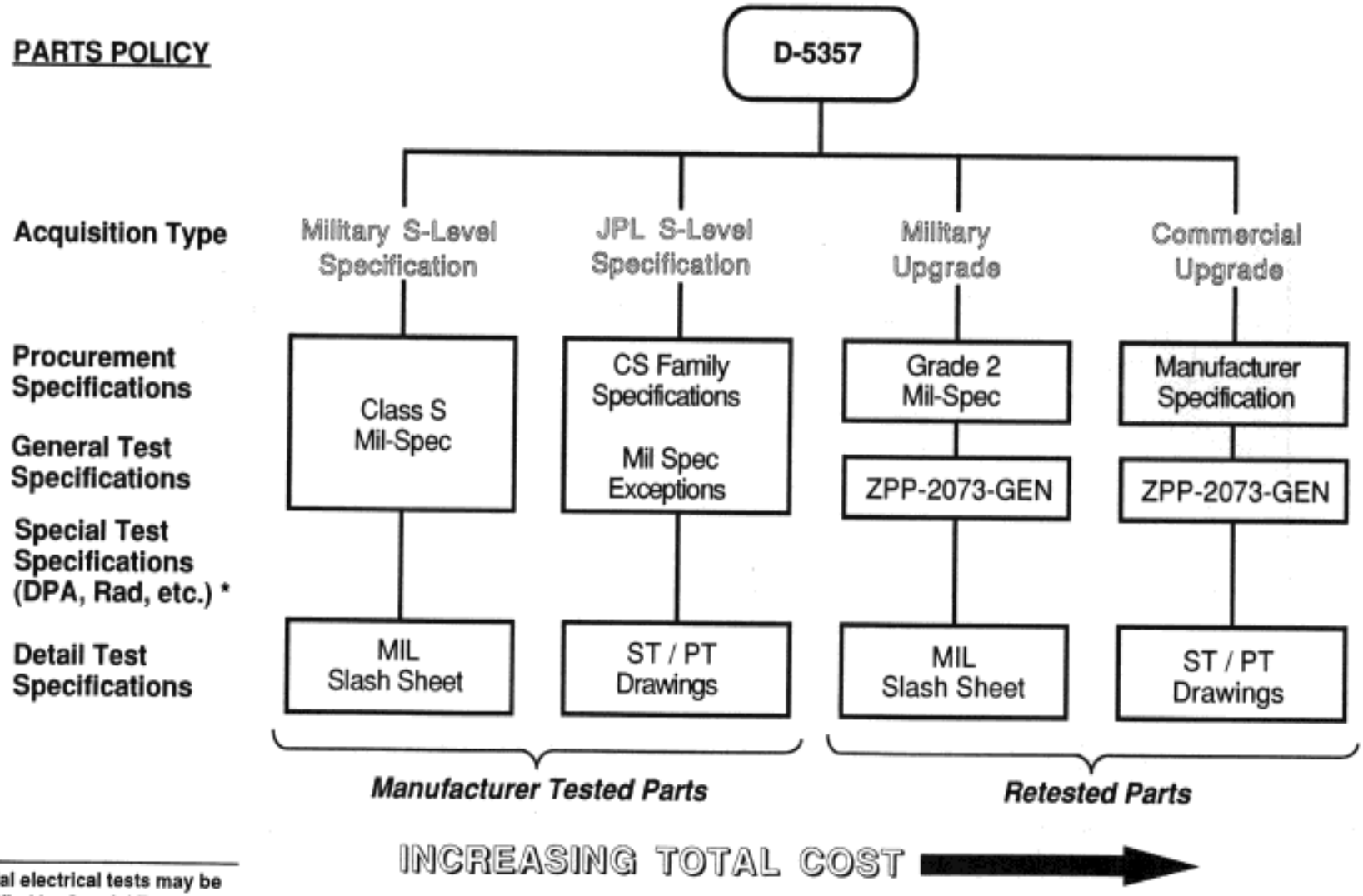
Document 51-D-01, *514 NSPAR Procedure,* describes the procedure for preparation and review of evaluation test plans, which may be necessitated by a lack of sufficient information on which to base approval or disapproval of a part for which a NSPAR has been submitted. Document 51-G-01 describes the Part Specialist's role in this process. Other specialists whose inputs may be needed are the Radiation Specialist (for TID and SEE test needs) and Failure Analysis Group personnel (for the performance of construction analysis).

4.4 PARTS ACQUISITION NEEDS IDENTIFICATION

Parts acquisition needs identification is the first of five steps in the acquisition of electronic parts for flight application. The five steps are:

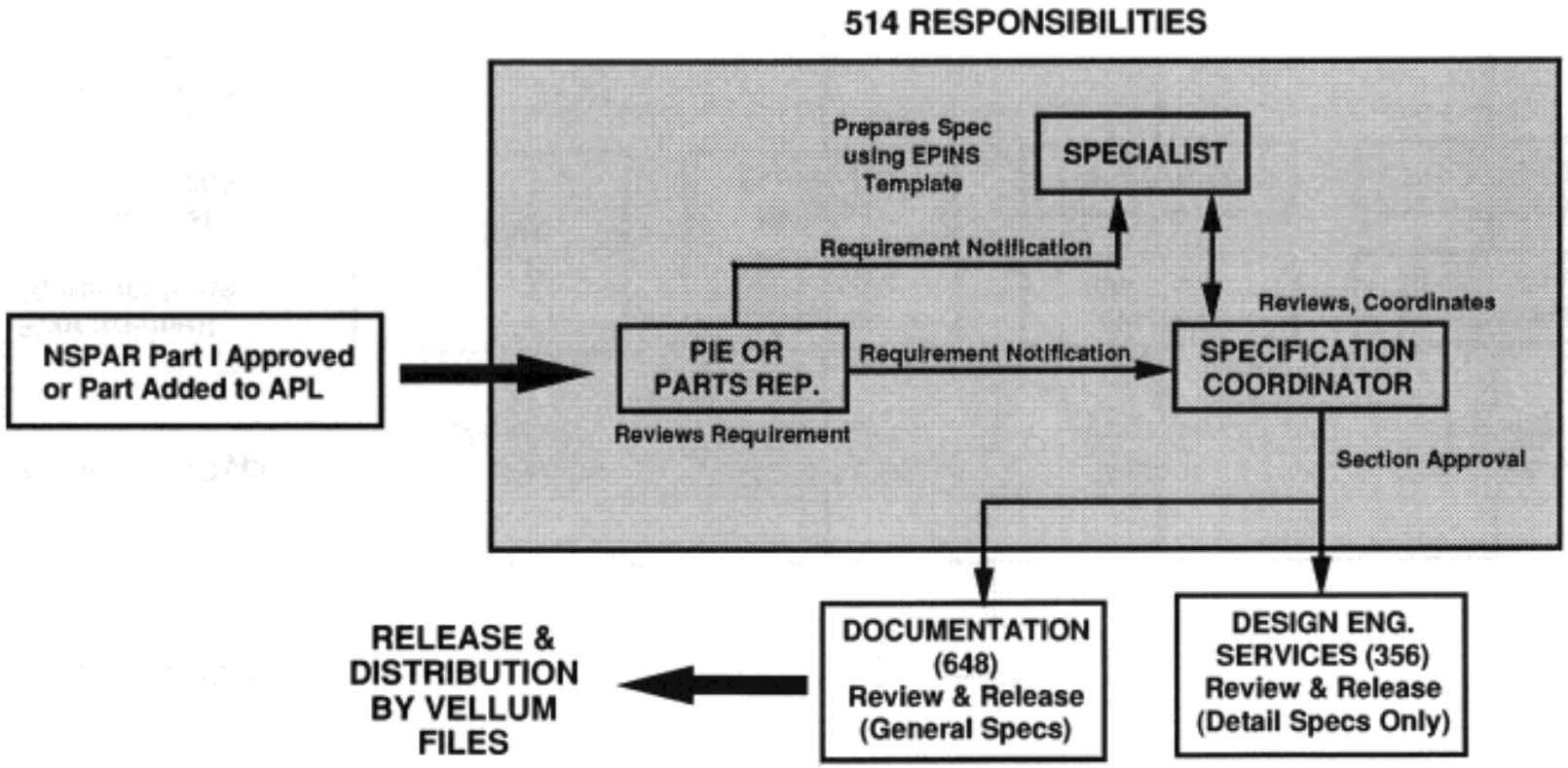
- Parts Acquisition Needs Identification
- Parts Procurement

SIMPLIFIED SPECIFICATION TREE



* Special electrical tests may be specified by Special Test Requirements (STR)

SPECIFICATION PREPARATION PROCESS



- Parts Fabrication/Monitoring
- Post-Manufacturing Processing
- Delivery to User

A simplified schematic showing the interrelationship among these activities is given in Figure 4.12a. In this and the following sections (4.4 - 4.8), each of the above steps is extensively described. Document 51-D-02 *JPL High-Reliability Parts Acquisition Process,* provides greater detail on this activity.

The Section works closely with the design organization to identify and document their parts needs. Because of the long procurement times associated with many high reliability parts, even tentative needs identification are solicited and entered into the EPINS. Needs identification is a highly interactive process between the Section, the design agencies, and the Project Office. It should be noted that the date the part is required is an integral part of the needs identification information required by the section

4.4.1 Parts Acquisition and Screening Order (PASO)

The Parts Acquisition and Screening Order (PASO), JPL Form 0279, is the means by which a Program authorizes the Section to start the acquisition process (including procurement and any necessary testing) for a specific quantity of a specific part type. Detailed characteristics of the part (package type, grade, etc.) and need date also are specified on the PASO. It is prepared by the Parts Representative and must be approved by the Subsystem or Instrument Cognizant Engineer.

The PASO is the initial data input used to produce and update the Parts Tracking System (PTS) module of the EPINS. The Parts Representative is responsible for the PASO data being entered into the EPINS system.

A transfer PASO is required to transfer parts from one project to another or from a given Program's "common buy" category to the specific user.

4.4.2 Parts Quantity Determination

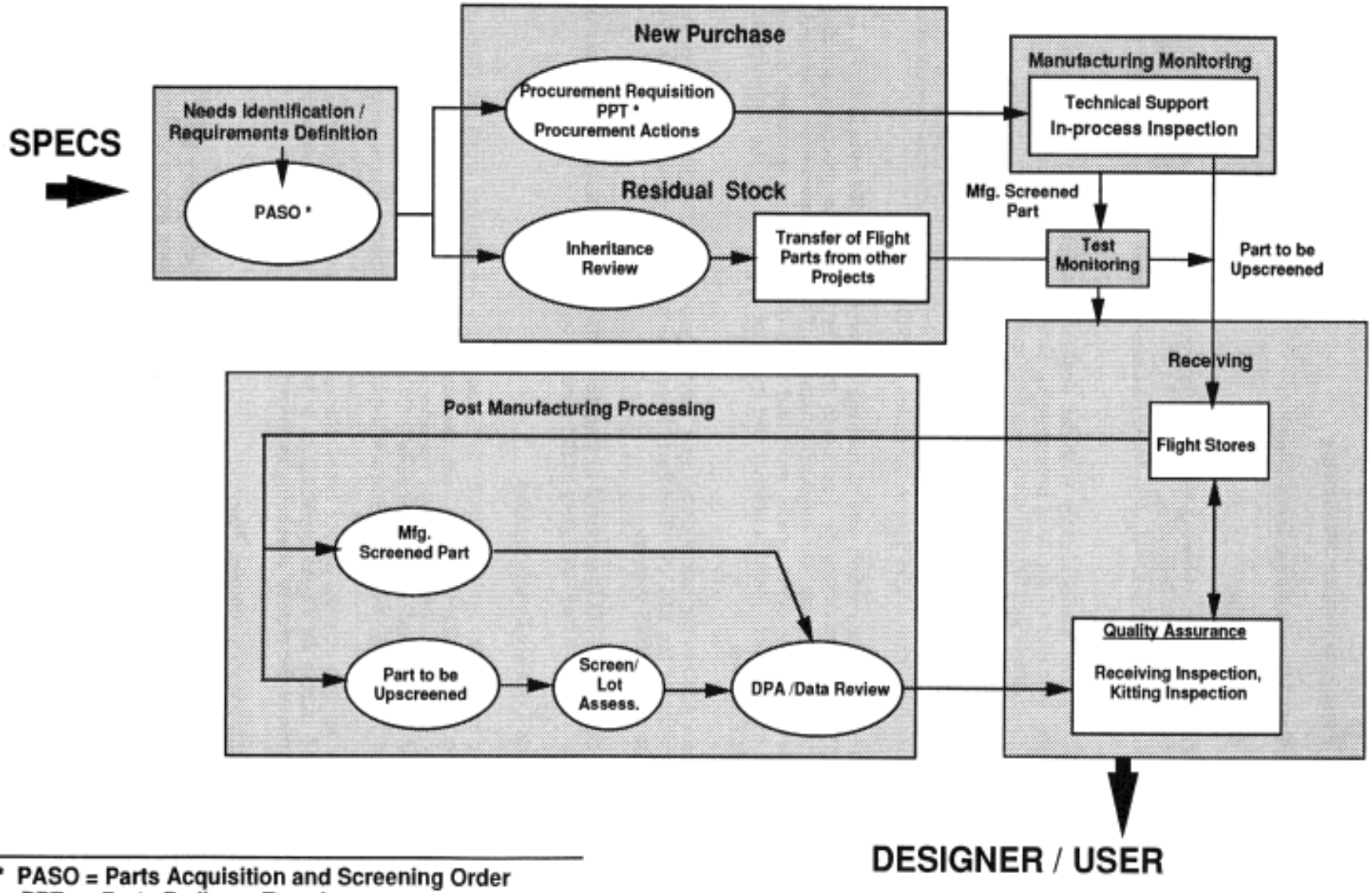
The part types and quantities to be acquired are derived from the Electronic Parts List (EPL) module of EPINS which lists the actual quantities needed by each user. Additional quantities are added for spares and for special testing such as quality conformance inspection (QCI) and DPA samples. The formula $2\sqrt{N}$ (where N is the quantity required by the user plus special test) is usually used to determine the quantity of spare parts to be included in the order.

For all microcircuit device types, life test parts that have undergone 1000 hour burn-in are considered usable for flight applications as long as the voltage / temperature conditions do not exceed those of the regular screening burn-ins.

4.4.3 Anticipatory Common Buy

In some cases a project will elect to conduct an "anticipatory buy" of parts. That is, parts expected to have high usage by subsystems and/or with long procurement times will be procured prior to actual needs identification by subsystem users. The quantities and types of parts to be procured in this manner are determined by the PPM and the project based on historic usage of the same or similar part types. When a project elects to conduct a centralized, anticipatory buy, several benefits accrue, e.g.:

SIMPLIFIED ACQUISITION FLOW DIAGRAM



* PASO = Parts Acquisition and Screening Order
PPT = Parts Pedigree Traveler

- Fewer minimum quantity parts buys (economy of scale).

- Less cost associated with specification preparation, placement of procurements, receiving, inspection, as a single large procurement (economy of scale).

- Greater flexibility in directing where parts shall be delivered first if demand temporarily exceeds supply.

- Higher probability of early identification and containment of any parts problems that may arise.

- Facilitates acquisition of long lead time items by initiating early procurement activities.

The anticipatory common buy tactic generally is used by large, Class A missions, for APL-listed parts common to several engineering subsystems; quantities may be added to cover anticipated science instrument requirements.

4.5 PARTS PROCUREMENT ACT IVITIES

Parts procurement activities relate to the acquisition of electronic components in accordance with a specific set of requirements and conditions. There are basically three parts procurement flows utilized by Section 514 in the acquisition of electronic parts. These are delineated in Figures 4.13, 4.14, and 4.15.

The first flow applies to the procurement of MIL electronic parts of a grade which satisfies a program's requirements without additional testing. For example, MIL-M-38510 class S parts usually need no testing (except for DPA) prior to use in Class A flight hardware.

The second flow applies to the procurement of electronic parts from manufacturers that are willing and able to satisfy Project requirements for manufacture and test. The manufacturer assumes the risk for failed parts loss and JPL receives only "good" parts. This differs from the first flow only in that the manufacturer is not MIL qualified for the part type and manufacturing and test are done to JPL specifications.

The third flow applies to the procurement of lesser grade (e.g., Grade 2 or Class B) electronic parts having additional tests performed by a test house or JPL to "upgrade" them sufficiently to meet the requirements of the mission. In this flow, there are three distinct stages which are illustrated in Figures 4.15a, 4.15b, and 4.15c. They describe, respectively, the parts procurement, contracting for screening services, and the actual screening.

4.5.1 Procurement Vehicles

Prior to beginning preparation of the procurement documents, a decision is made as to which procurement vehicle is to be used.

4.5.1.1 Indefinite Delivery Contracts (IDC)

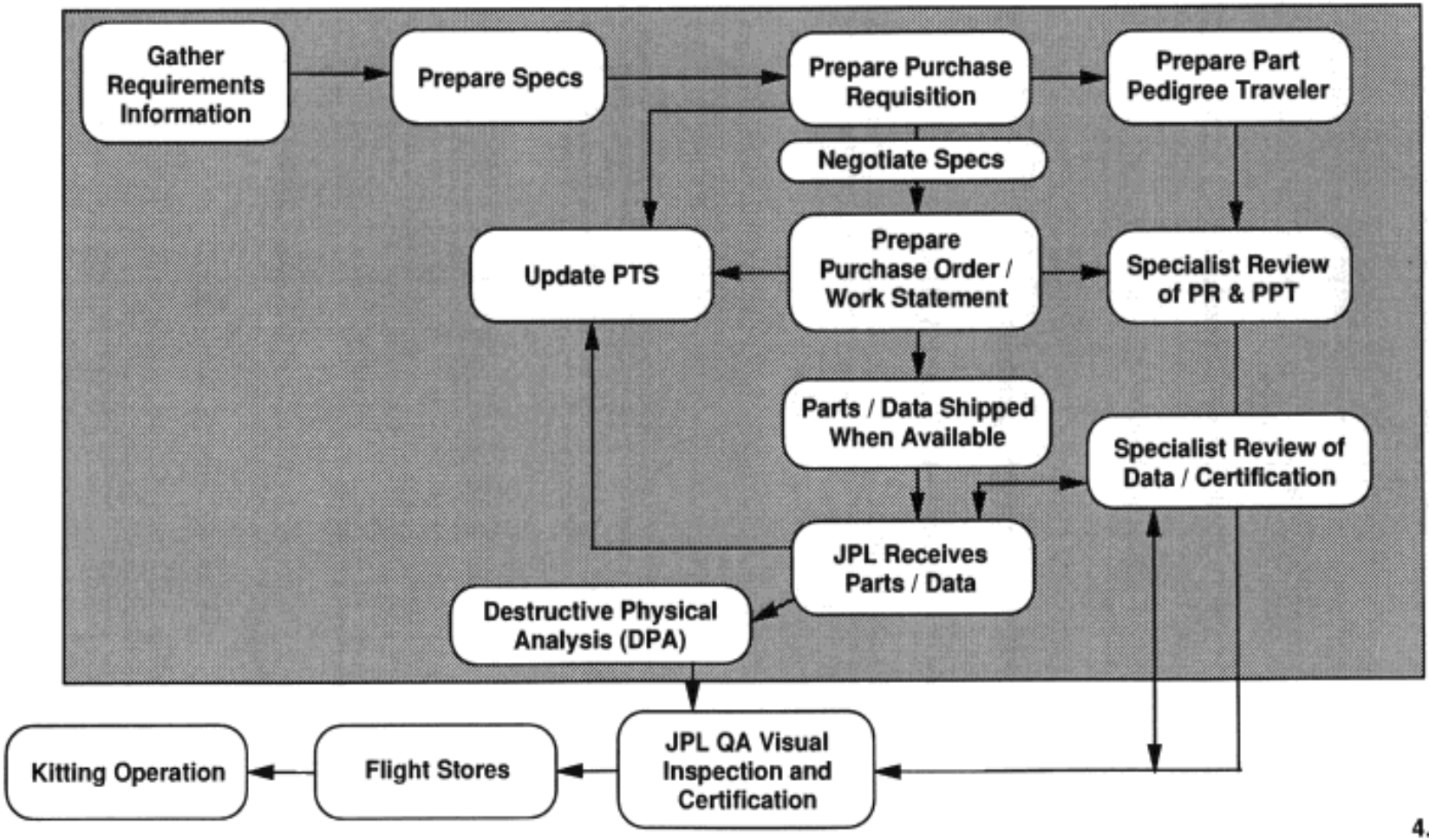
Indefinite Delivery Contracts (IDCs) are contracts between the Laboratory and a manufacturer that allow for the delivery of an undetermined number of parts of a specified type(s) at an indefinite time in the future. These procurement contracts have the following characteristics:

ELECTRONIC PARTS RELIABILITY

PROCUREMENT FLOW

MIL CLASS S OR ACCEPTABLE MIL GRADE FOR MISSION CLASS

514 RESPONSIBILITIES

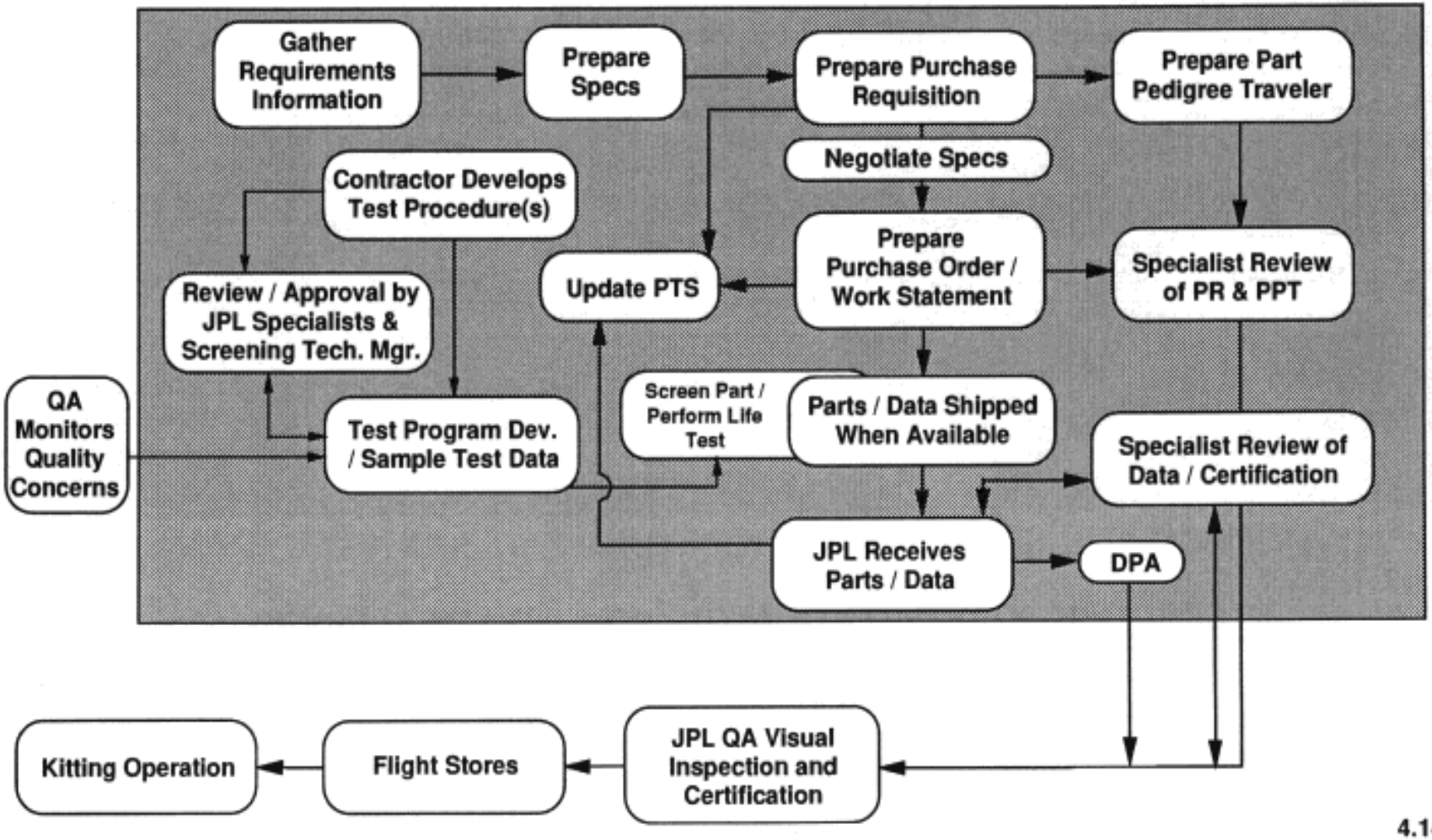


ELECTRONIC PARTS RELIABILITY

PROCUREMENT FLOW

CLASS S EQUIVALENT OR GRADE SUITABLE FOR MISSION CLASS - MANUFACTURER SCREENED

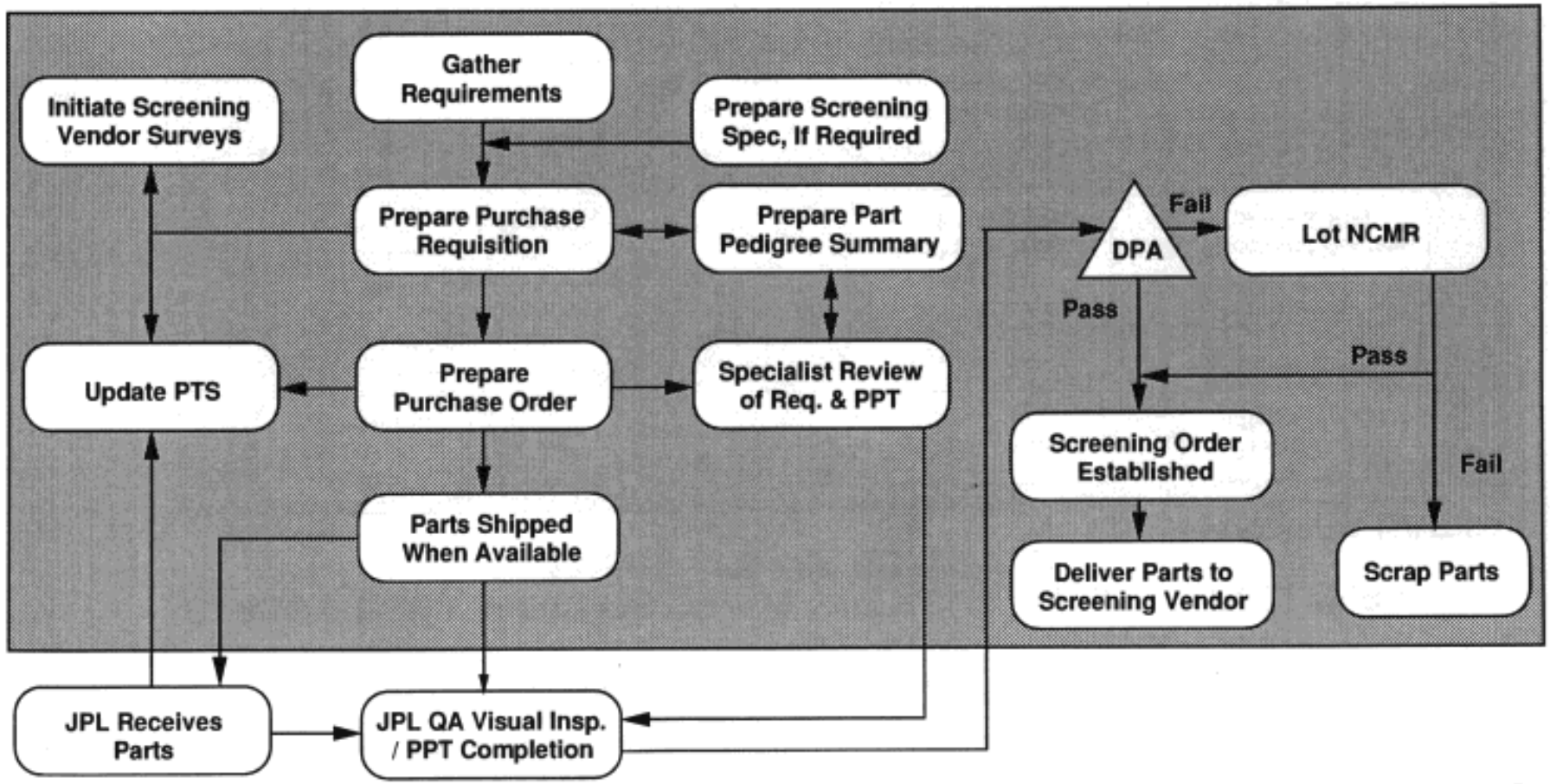
514 RESPONSIBILITIES



ELECTRONIC PARTS RELIABILITY

PROCUREMENT FLOW

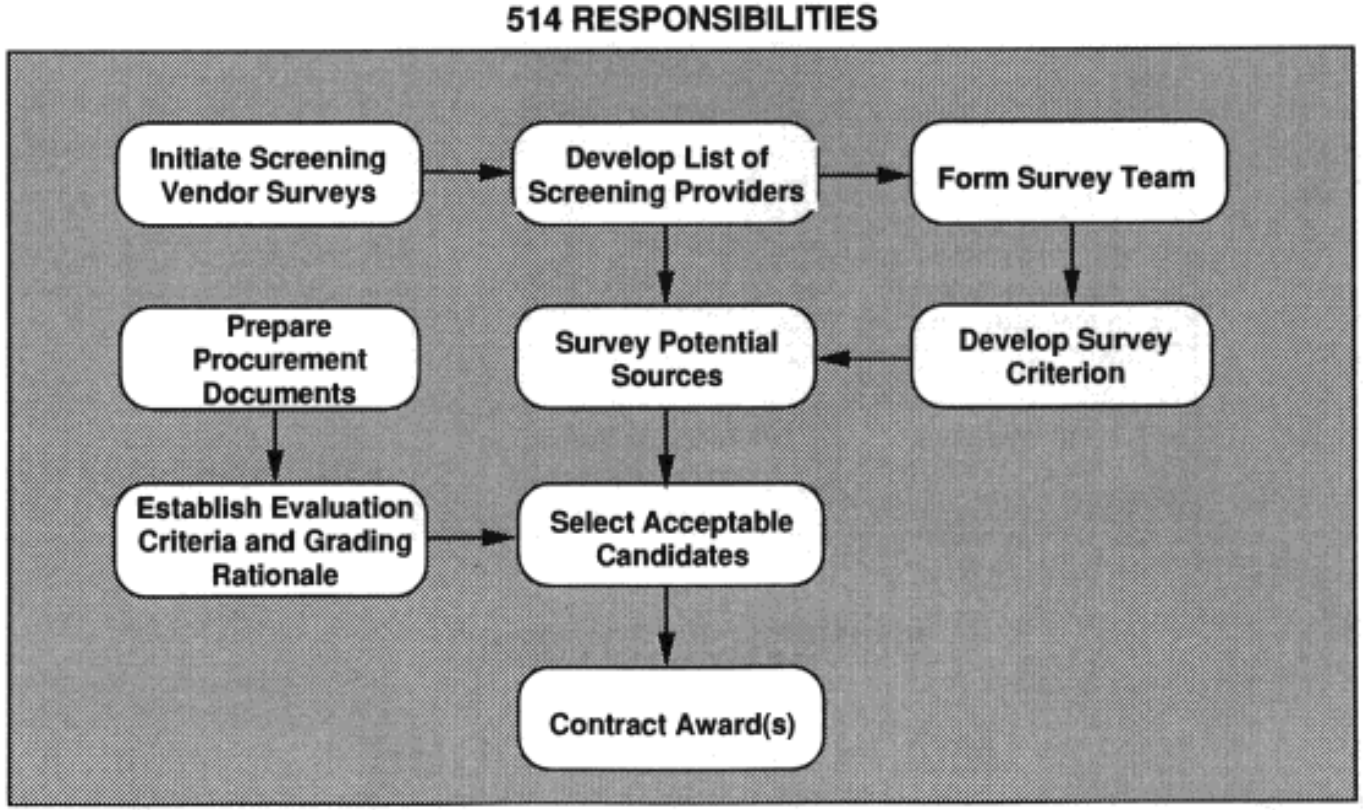
CLASS B OR COMMERCIAL PART - UPGRADE REQUIRED



ELECTRONIC PARTS RELIABILITY

PROCUREMENT FLOW

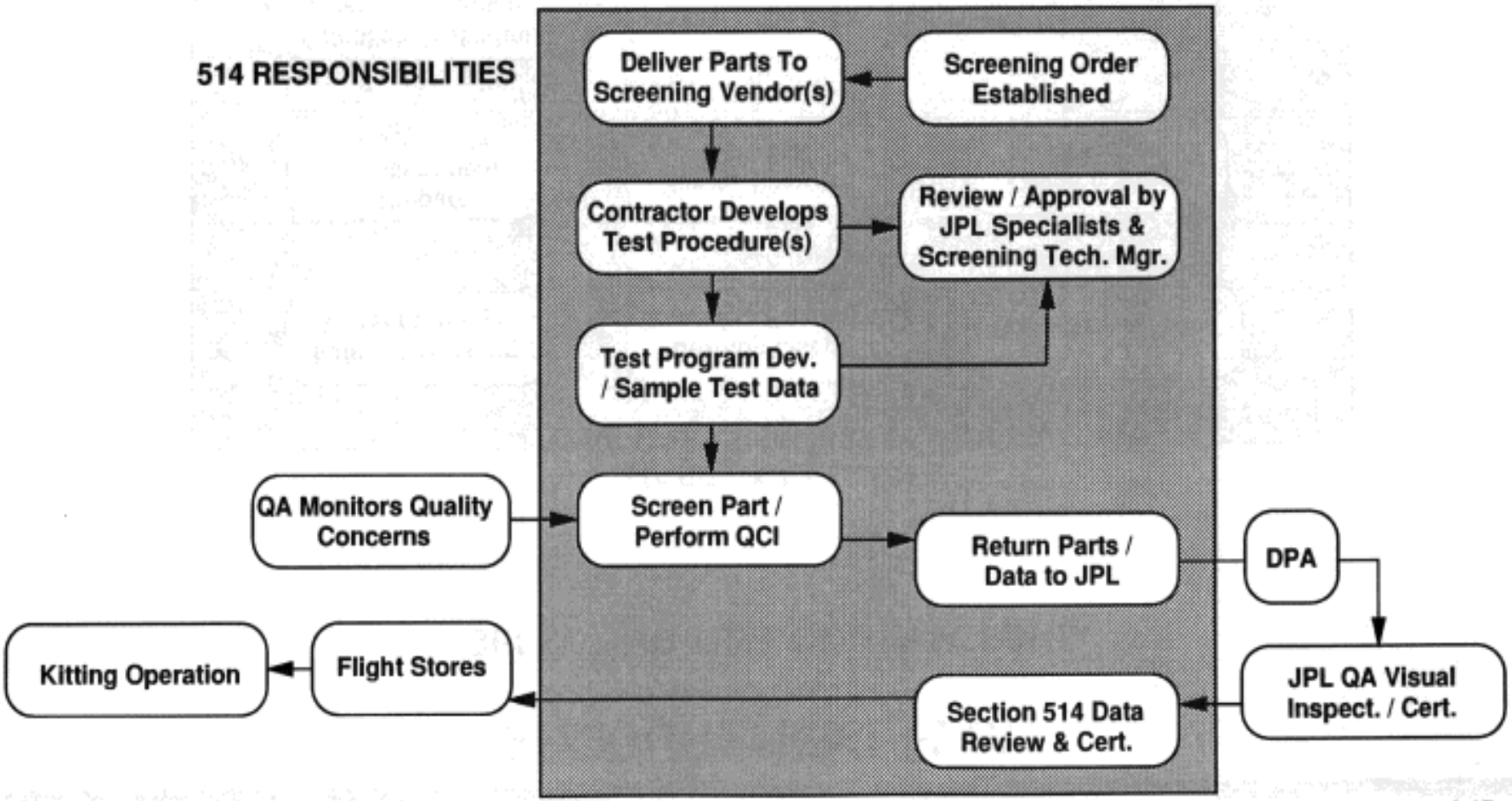
SELECTING TEST CONTRACTORS



ELECTRONIC PARTS RELIABILITY

PROCUREMENT FLOW

UPGRADE SCREENING



- The general contractual Terms and Conditions (Ts & Cs), unit price and specifications are agreed upon
- The total number of parts of each type is estimated
- The term of the contract period (i.e., one or two years) is specified, but the specific delive ry dates are not

As requirements become known, order releases for specific quantities of specific parts are issued and delivery dates set. The IDC is used most commonly in cases where specific requirements are uncertain and

- many different part types will be procured from a particular vendor,
- the parts are complex and involve substantial "start up" effort, or
- multiple variants of a design will be required (e.g., ASIC gate arrays, PROMs) and the specific number of variants is not known. This procurement vehicle makes it possible to place orders quickly once specific requirements are known.

4.5.1.2 Fixed Delivery Contracts

Fixed delivery contracts and Purchase Orders (PO) require the delivery of a specific number of parts by a specified date. These contracts are utilized for the procurement of parts where the quantity required is relatively well known and therefore only one procurement is anticipated. Any subsequent requirements can be secured with the initiation of a separate procurement, i.e., contract or purchase order, or by modifying the contract or purchase order if the manufacturer or vendor agrees.

4.5.2 Procurement Sources

4.5.2.1 Procurement Directly From Manufacturers and/or Distributors

- Parts procured to MIL specifications or JPL Source Control Drawings (SCD) are obtained directly from the manufacturer.
- Commercial grade parts, parts procured to Class B Military specifications, and many passive devices are generally obtained from distributors.

4.5.2.2 Acquisition of Parts from JAN S Stocking Program

The Defense Logistics Agency (DLA), the Air Force Space Systems Division (SSD), and the National Aeronautics and Space Administration have established a stockpile of JAN Class S parts. These stocked parts are available to users with government contracts and commercial Expandable Launch Vehicle (ELV) manufacturers with commingled military / commercial production lines.

The JAN S Stocking Program is the preferred source of parts for all programs requiring Class S parts, subject only to the requirement that the parts meet all requirements contained in the respective project's PPR. Upon delivery of parts from the program, the applicable lot specific data shall be obtained from the part manufacturer for review by the Part Specialists.

The availability of parts from the stocking program can be verified via the SSD electronic JAN Class S stock Bulletin Board. Ordering of specific parts is accomplished through the JPL

Project Stores management (Section 645).

Parts are procured for the stockpile based on actual or projected system requirements of the potential users. It is the responsibility of the Parts Acquisition Group to supply the Program with projections of JPL parts requirements as requested.

4.5.2.3 JAN Class "S" Space Level Overage List

A list of companies, with Government contracts, with overages of possibly acceptable parts, is published periodically. These are investigated for JPL program use.

4.5.2.4 Residual Parts Inventory

An inventory of each flight project's residual parts is maintained by Project Stores (Section 645). A Project's Parts Program Manager is responsible for handling requests for any residual parts that belong to his Project. Approval to sell or give the parts to another project must be obtained from the appropriate manager of the project that owns the parts. When that approval is obtained, the PPM implements the transfer and arranges for the posting of the cost of the parts to the "buying" project. See paragraph 4.8.3.

4.5.3 Procurement Document Preparation and Review

4.5.3.1 Procurement Requisition (PR)

Upon receipt of a signed PASO for off-the-shelf parts which do not involve specifications or special statements of work, the Parts Representative or Parts Interface Engineer (PIE) gives the information directly to the Procurement Coordinator (PC) for preparation of the PR. When the PASO requires a more complex procurement, he gives the information to the appropriate Contract Technical Manager (CTM), who assembles the necessary specifications and requirements and passes them on to the PC for issuance of the PR. A Trace Number unique to each line item is assigned; it will be the principal means of tracking the procurement and data. A given PR may combine requirements of several PASOs. The CTM or Parts Representative reviews the PR for accuracy and completeness (and to make certain that any necessary documentation is attached), and returns to the PC, who routes it through the required cycle to the Procurement Section.

4.5.3.2 Part Pedigree System (PASS) Documents

The Parts Representative prepares a Part Pedigree Traveler (PPT) for each line item of the PR and secures the approval of the Parts Specialist prior to release of the PR. Section 6.7 herein describes the PPS in greater detail.

4.6 PARTS FABRICATION MONITORING

The Parts Acquisition Group (PAG) is responsible for monitoring schedules of all flight and Engineering Model (EM) parts procurements and for technical monitoring as well of contracts involving many types of parts procured to custom specifications.

4.6.1 Procurements to Custom Source Control Drawings (SCDs)

The CTM is the principal JPL technical interface with manufacturers and is responsible for coordinating the activities of Procurement personnel (buyer or negotiator), Parts Interface Engineers, Electronic Parts Quality Assurance (EPQA), Parts Specialists, PA personnel, and users in relation to the contract or PO. See paragraph 5.4.6 for more detail.

EPQA may perform audits of the contractor's manufacturing and QA operations and usually performs one or more in-process inspections. The Parts Specialist may participate in EPQA audits and also will review test programs and procedures for compliance with the SCD. He also may become involved in efforts to solve problems which arise during the manufacturing and test cycles. Part failures may be submitted to the Section FA Group for analysis.

4.6.2 Procurements to MIL Specifications

When MIL parts are procured from a distributor or from the JAN S stockpile program, no JPL in-process monitoring occurs. If, however, an order is placed for a manufacturer to produce parts to a MIL specification for delivery specifically to JPL, the contract monitoring activities are similar to those for SCD contracts.

4.7 POST RECEIPT PROCESSING

Processing of parts received from a vendor is determined by the requirements listed in the respective PPT for that part. All incoming parts are subject to receiving inspection by QA. All required recorded data must be reviewed by the Section Parts Specialist. Other types of processing include the following:

- DPA as required by JPL D-5357 or PPR
- "Upgrade" testing of parts to meet requirements of the user mission class (followed by QA inspection and data review)
- Special tests (e.g., surge current test for certain capacitors, reburn-in at different voltages for ICs for special applications) followed by QA inspection and data review

The Section 514 Parts Representative is responsible for coordinating completion of the PPT requirements. EPQA is responsible for filing the original of all PPTs and Part Inspection / Review Certifications (PIRCs).

4.7.1 Parts Receipt

Parts are received by the JPL Shipping and Receiving Group. Shipments are verified (unopened) by comparing the purchase order to the vendor's shipper, then forwarded to JPL Project Stores. There, they are verified against the purchase order line item and logged into the unique-project stores inventory "awaiting inspection" category. Parts and accompanying data are passed to JPL Receiving Inspection.

4.7.2 Parts Receiving Inspection

All incoming parts are inspected prior to entering the JPL Project Stores conforming inventory. Parts previously inspected by JPL QA Source Inspectors move to stores with a cursory visual inspection for damage and a verification of pedigree status. All other parts undergo visual microscopic inspection and verification of dimensional compliance with purchase order, specification, and the requirements of the unique PPT.

Visually good parts are maintained in QA impound, pending data review. Data accompanying parts are forwarded for review by the JPL Specialist. JPL Quality Assurance verifies the completeness of the parts data review by the JPL Parts Specialist. Parts rejected by the Specialist are segregated for Non-Conforming Material Review (NCMR) abeyance, pending

disposition.

Visual rejects are held by QA in abeyance, pending NCMR disposition. After completion of inspection and data review, acceptable parts are placed in Flight Stores.

Parts inspection details are documented on the Parts Inspection / Review Certification (PIRC), and the appropriate steps of the PPT are stamped to show progress. The PIRC is shared with Parts Reliability to record the status and certification of parts. NCMR is conducted on the PIRC, if required.

Upon completion of NCMR action, parts are dispositioned per agreement. If all parties cannot agree on NCMR disposition, the procedures listed under section 3.4 shall be followed.

4.7.3 Parts Data

4.7.3. 1 Review

All electrical, mechanical, and environmental / evaluative data accompanying parts are reviewed by the Parts Specialist or QA, as applicable, for compliance with specification.

Data review emphasizes careful attention to the order of testing, instrumentation accuracy, and the completeness and accuracy of parameters measured for compliance with detail test procedures and plans. Special test requirements identified for initial or upgrade testing are also verified in this review process.

With large volumes of data, the review allows for audit of parametric data, with a 100 percent data review where a problem is found.

The Section Parts Specialist approves / disapproves the data on the PIRC, which is forwarded to database entry and subsequently verified as complete by JPL Quality Assurance.

JPL QA verifies the completeness of the parts data review by the Parts Specialists. Parts rejected by the Parts Specialist are recalled from JPL Project Stores and segregated pending disposition of any NCMR action.

4.7.3.2 Data Archiving

All electronic parts data are inventoried by Trace number and any other identifiable factors such as lot number, part number, etc. The archived data storage location is entered into the EPINS to facilitate retrieval by trace number. To find the specific part data, the trace number must be known. The trace number allows the storage box containing the actual data to be retrieved from the JPL record storage center.

A log is maintained for all retrieved data to assure it is returned to storage as soon as practical. Trace numbers are now being used in the kitting of parts and also are expected to be used in the "as-designed" lists.

4.7.4 Non-Conforming Material Review (NCMR)

NCMR is the process by which individual parts or entire lots of parts are reviewed for conditions failing detail specifications or other PPT requirements. Suspect parts are held by Quality Assurance in NCMR abeyance, pending disposition.

NCMR disposition requires the mutual concurrence of the Part Specialist, Project Part

Representative or Parts Interface Engineer, and Parts Quality Assurance Engineer. When the non-conformance affects form, fit, or function, the signature of the Cognizant Engineer (user) is required and a rationale must be noted on the NCMR. The Project Part Representative coordinates the NCMR process to its conclusion and is the liaison to the user to resolve all related matters.

Parts dispositioned as acceptable (use as is) move to Project Stores. Others may be downgraded to non-flight status and placed in inventory so designated. Rescreen or special test instructions are carried over to other Part Pedigree System paperwork for follow-up. Still other parts or lots of parts may be returned to the vendor or scrapped and replaced.

Quality Assurance closes the NCMR only after any required actions are completed.

4.7.5 Rescreening (Upgrade) of Parts

The most common reason for rescreening is that the PPR requires more testing than has been done prior to initial receipt of the parts. Document ZPP-2073-GEN lists the screening and lot acceptance test requirements for the various mission classes. Requirements for rescreening are listed on the PPT.

The Section Parts Representative initiates a PIRC, which is used for recording results of QA visual inspections and Section data reviews. If the screening is to be done on-Lab, the Section Screening Coordinator issues an Inspection and Test Request (ITR) to withdraw the parts from Stores. If they are to be delivered to an outside contractor for test, he initiates a JPL Shipping Memorandum Request to do so. QA makes certain that parts withdrawn for testing have passed visual inspection and that traceability is adequate and repeats the inspection after testing is complete and before return to Stores. The screening agency summarizes test results on the Test Data Summary (TDS); the TDS and detailed test data are reviewed by the Parts Specialist, who records results (classifying parts as flight or non-flight) on the PIRC. EPQA reviews the PIRC to make certain that all non-flight parts have been removed from the flight lot. (See section 6.7).

4.7.5.1 Special Screening and Lot Acceptance Tests

Screening and lot acceptance tests other than the standard rescreening operations can be required on the PPT. The Section Parts Representative initiates a Special Test Review Certification (STRC) and may have the Parts Specialist prepare a Special Test Requirement form to specify the test methods and procedures. Upon completion of the testing, the Parts Specialist reviews the test data and approves/disapproves it on the STRC. Part-handling procedures are the same as those for standard rescreening.

4.7.5.2 Monitoring of Testing

The Section Screening Coordinator is the principal JPL technical interface with test agencies and is responsible for coordinating the activities of Procurement personnel (buyer or negotiator), EPQA, Parts Specialists, FA personnel, and users in relation to the testing contract or PO. See paragraph 5.4.7 for more detail.

EPQA may perform audits of the Contractor's QA operations. The Parts Specialist may participate in these audits and also will review test programs and procedures for compliance with the specifications. He also may become involved in efforts to solve problems which arise during testing. Part failures may be submitted to the Section FA Group for analysis.

4.7.5.3 Quality Assurance Surveillance of Testing

Surveillance of upgrading and special testing emphasizes compliance with test setup specification, approved test procedures and plans, test area readiness, test documentation, and safety of parts through delivery. JPL Quality Assurance also verifies the survey approval status of each screening facility and participates in corrective action measures when problems arise. While part failure analysis and destructive parts analysis are technical activities, Quality Assurance monitors the parts handling and pedigree status of suspect parts to assure integrity of the lot pedigree.

4.7.6 Destructive Physical Analysis (DPA)

JPL D-5357 describes-the DPA requirements for the various JPL mission classes; ZPP-2078-GEN, *General Specification for Destructive Physical Analysis of Electronic Parts,* describes sampling procedures and specific tests to be performed for each part family. If DPA is required by the Project PPR, the Section Parts Representative so indicates on the PPT. He prepares an STRC when the lot of parts from which the DPA sample is to be drawn has been received and delivers it to the Section FA Group. The FA Group either performs the DPA or contracts with an outside laboratory to do so, then reviews the report and approves/disapproves the results on the STRC.

4.8 DELIVERY TO USER

The final step in the acquisition process is kitting the parts to the user (Figure 4.16). Separate stores are maintained for flight and non-flight parts. Project Stores assigns a unique stores number for each project (based on the account number under which the parts were procured), and maintains records to distinguish parts procured on the account numbers of specific subsystems or instruments.

4.8.1 Parts Delivery (JPL Users)

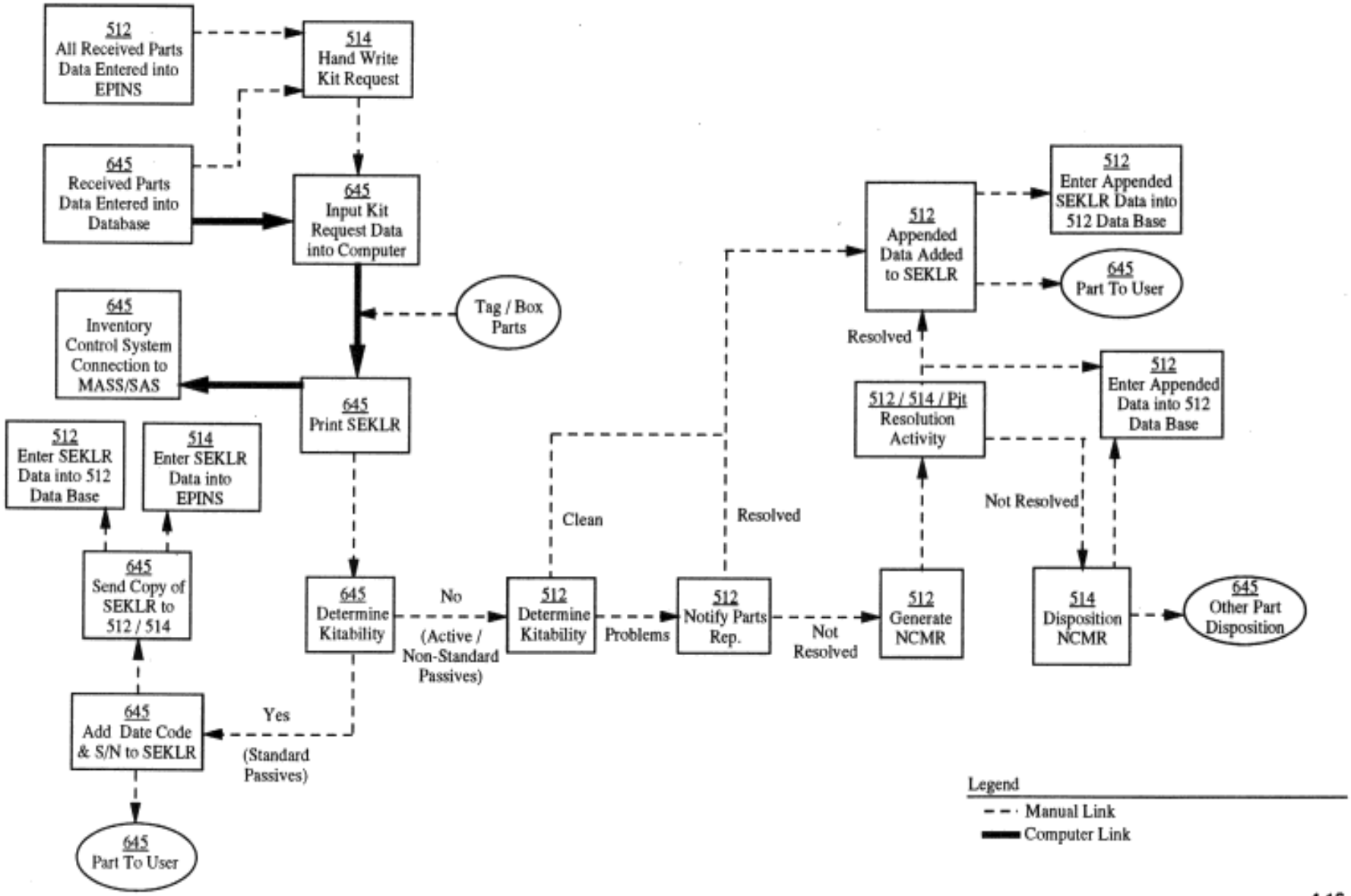
The process begins when the Section 514 Parts Representative prepares a Shipper Exhibit Kit List Request (SEKLR) listing part number, Trace Number, lot number and quantity for each line item to be kitted, and the user account code if it is different from that under which the parts were procured. Kits may be in bulk (for all boards) or for an individual board, depending on agreements made with the Program. Project Stores assembles the parts and gives them and the SEKLR to EPQA, where the PPT for each line item is checked for completeness and verified to be free of liens. Standard MIL passive devices with no liens can be kitted directly from Project Stores. If discrepancies are found, the parts are held in EPQA pending resolution (which may involve NCMR or waiver action). The kit then is returned to Project Stores for release to the user, who assumes responsibility for maintenance of traceability and flight acceptability.

4.8.2 Parts Delivery (Non JPL Users)

4.8.2.1 Domestic Users

Parts are kitted to the JPL representative of the non-JPL user, who is responsible for initiating the JPL shipper to allow the parts to be removed from the Laboratory. The NASA form, DD-1148, is also required if there is a change of ownership. If there is no JPL representative for the non-JPL user, the Section PPM will process the required forms. In either case, the PPM is responsible for assuring that the appropriate cost of the parts is transferred to the user.

KITTING PROCESS - CURRENT FLOW



4.8.2.2 International Users

When shipping parts to international users, the same general procedures are followed as defined above for domestic users. In addition, however, the International Affairs Office should be consulted to determine what export licenses are required and whether the parts shipment falls under the restrictions of the U.S. States Department and International Traffic in Arms Regulations (ITAR) controls.

4.8.3 Release of Program-Procured Parts to Another User

The Section is preparing a Laboratory Standard Practice Instruction (SPI) to address this matter. Prior to launch of the Program for which the parts were procured, parts may not be kitted out to a different user without the authorization of the manager of the Program which owns the parts. The Parts Representative for the Program requesting the parts gives the SEKLR to the Parts Representative or PIE for the Program which owns them; the latter requests authorization from the Program Manager or his designee and signs the SEKLR if it is granted. After launch, the procuring Program must provide direction as to whether parts may be released. (e.g., there may be activity continuing after launch or a follow-on build may be anticipated.) Parts released after launch are available at no charge to other programs. The procuring program must provide justification for not releasing parts.

Project Stores sends a listing of those lots of parts which have experienced no transactions (receipts or kits) during the previous 12 months and which are scheduled for possible placement in long term storage. The Section Parts Representative and PPM reviews this list and indicates which items should be retained in Project Stores and the reason for doing so.

4.8.4 Return of Surplus Parts to Flight Stores

The intent of this paragraph is to establish some guidelines and methodology for the return of surplus electronic piece parts from users (both JPL Technical Divisions and JPL contractors). The purpose of the guidelines is to allow for the use of flight parts by future programs. D-5357 provides guidelines for programs wishing to use these residual parts.

It is assumed that:

- Only high cost or long-lead time parts will be returned for possible future flight use. Low cost, easily obtainable parts which don't warrant the time or cost to maintain flight pedigree will be retained by the user or placed in-non-Flight Stores.

- Contractor-procured flight parts are fully certified with pedigree paperwork available in the Contractor's files for possible audit by Section 514 and EPQA.

- Traceability and handling after kitting have been consistent with requirements for flight parts.

4.8.4.1 JPL Built Subsystems

It is the responsibility of the Section's Parts Program Manager to insure that the requirements of 51-D-03, *Guidelines for Kitting of Flight Electronic Parts and Return of Surplus (Residual) Parts to Stores,* have been met (i.e., handling and traceability maintenance have been appropriate). is applied to all parts returned from JPL in-house subsystems in order to insure proper handling and return of residual inventory to JPL bonded stores.

4.8.4.2 Contractor Built Subsystems

Each JPL subsystem contract has a provision for the return of residual electronic piece parts and specifies how it is to be accomplished. It is the responsibility of the PPM to insure that each system contract contains a procedure consistent with 51-D-03 to insure proper handling and return of residual inventory to JPL bonded stores.

4.9 ELECTRONIC PARTS APPLICATIONS

TBD

4.10 OTHER ELECTRONIC PARTS RELIABILITY ISSUES

4.10.1 Government-Industry Data Exchange Program (GIDEP)

GIDEP is a cooperative data exchange among Government and Industry participants. Section 514 is the designated GIDEP interface for the Laboratory. This interface is accomplished via the GIDEP Representative within the Section.

4.10.1.1 GIDEP Data Banks

Participants in GIDEP are provided access to four major data banks:

1) The Engineering Data Bank (EDB) contains engineering evaluation and qualification test reports; nonstandard parts justification data; parts and materials specifications; manufacturing processes; failure analysis data; and other related engineering data on parts, components, materials, manufacturing processes, systems, and equipment.

2) The Metrology Data Bank (MDB) contains related metrology engineering data on test systems, calibration systems, and measurement technology and test equipment calibration procedures.

3) The Failure Experience Data Bank (FEDB) contains objective failure information generated when significant problems are identified on parts, components, fluids, materials, or safety information.

4) The Reliability-Maintainability Data Bank (RMDB) contains failure rate/mode and replacement rate data on parts and components based on field performance information and/or reliability demonstration tests of equipment, subsystems, and systems.

4.10.1.2 Manufacturer Test Data And Reports

The GIDEP database also includes test data and reports from manufacturers of commercial high reliability parts, components, and materials used to determine device compliance with established specification requirements.

4.10.1.3 Special Services

Several special services are provided within GIDEP. These are:

The Urgent Data Request (UDR) system, by which a GIDEP participant may query all

other GIDEP participants on specific parts, components, material, and process data, or solicit other critical information not available from other sources.

The ALERT system (see paragraph 4.10.1.4 below) provides the GIDEP participants with identification and notification of actual or potential problems; non-random or failure trends on parts, components, materials, manufacturing processes, and test equipment; or safety problems (SAFE-ALERTS). The ALERT data constitutes a portion of the computerized Failure Experience Data Bank.

GIDEP also provides information to manufacturers. A copy of test reports, calibration procedures, and ALERTS are sent to the manufacturer for comments prior to submittal to GIDEP.

A limited international reliability data exchange program on electronic parts test data has been established between GIDEP and its international counterpart, the International Exchange of Authenticated Electronic Component Performance Test Data (EXACT) Program. EXACT data are now included in the GIDEP Engineering Data Bank. However, only GIDEP Engineering Data Bank data that indicate good material are transmitted to EXACT.

4.10.1.4 JPL ALERT / Concerns System

The purpose of the JPL Alerts/Concerns System is to establish a standardized method to alert JPL Project/task offices, safety offices, quality assurance and reliability, and other appropriate offices of parts and material problems identified by GIDEP and internal communication. They include the following:

- Mechanical, hydraulic, electrical and electronic parts, microcircuits, and microcircuit modules.
- Materials associated with the foregoing, such as ferrous and nonferrous metals, plastics, sealants, lubricants, insulators, wire, solder, fluxes, shielding, and hydraulic fluids.
- Materials used in aerospace structures.
- Safety problems or hazards.

SPI 7-01-14, *NASA Alert System,* dated April 1, 1984, designates Section 514 as the JPL organization responsible for the implementation of the system at JPL. Document 51-A-02, *Alerts/Concerns System Plan,* establishes the Section policies, responsibilities, requirements, and procedures for implementing the system. This plan provides for notification of all concerned agencies and documentation of their responses.

This plan outlines the procedure for processing JPL responses to internally identified problems, ALERTS, and SAFE-ALERTS received from National Aeronautics and Space Administration (NASA) Headquarters, NASA field installations, NASA contractors, and companies participating in GIDEP and JPL release of ALERTS and SAFE-ALERTS. This plan is in conformance with JPL SPI 7-01-14. The Alert / Concerns System is integrated in EPINS.

4.10.2 Parts Information Program (PIP)

The Parts Information Program is a JPL internal notification system by which news on pertinent and recent changes concerning electronic parts is disseminated. The management of the program is the responsibility of the Discrete Parts and ICs Group (5142); PIPs are generally initiated by Parts Specialists. Topics covered by the system include:

- Parts availability or replacements.
- Application information and precautions.
- Product-analysis results.
- New test/inspection capabilities.
- Problems with JP-peculiar parts or processes.
- Summary of parts qualification / evaluation test results.

Document 51-G-01, Parts Specialists Guidelines, contains detailed information on the PIP preparation process.

5.0 SECTION ORGANIZATIONAL STRUCTURE

5.1 INTRODUCTION

The purpose of this section is to establish the charter, organizational structure, and respective role statements of Section 514. The organizational structure shown and discussed is primarily that of the Section and its group and subgroup elements.

5.2 SECTION CHARTER

The charter for the Section as contained within the Division 51 charter is as follows:

"The major responsibilities of this Section are to:

- Provide engineering support to JPL flight projects in:

  (1) establishing requirements for selection, procurement, screening, and application of electronic parts, and

  (2) reviewing performance relative to these requirements.

- Establish and maintain the Laboratory Preferred Parts Lists of controlled parts, including supporting specifications, application data, and evaluation data.

- Generate, maintain, and control Approved Parts Lists as required in support of Laboratory flight projects.

- Provide for the timely acquisition of flight-quality electronic and microelectronic parts, as required, in support of Laboratory flight projects; and maintain records of those parts.

- Accomplish the required screening and burn-in of electronic parts in-house or through contracts with industry, as appropriate.

- Establish a management information system to provide flight projects with status information on the progress of all aspects of their parts acquisition and parts reliability programs.

- Coordinate and implement JPL participation in the ALERT program and represent JPL on Government/industry electronic parts boards and committees.

- Participate in design reviews and material review board activities.

- Provide technical support for failure investigations and analyses of electronic and microelectronic parts.

- Provide silicon brokerage service for acquisition of flight quality semi-custom and custom microelectronic devices designed by the Technical Divisions.

- Provide technical support for radiation tests, environmental, measurements, and data analysis of electronic and microelectronic parts.

- Perform research and advanced development of evaluation techniques relating to microelectronic parts.

The Section is accountable for operating, managing, and maintaining the capability of the following special technical facilities:

- Failure Analysis Laboratory
- Electronic Parts Evaluation and Screening Laboratory
- High Flux Radiation Facility (Gamma Ray)
- Low Dose-rate Radiation Laboratory (Cesium)

This charter has been summarized by the Section into the following specific functions:

- Parts program control.
- Evaluation of new parts and technologies.
- Qualification testing and accelerated life testing.
- Development of LSI qualification techniques.
- Radiation effects, hardening, hardness assurance.
- Acquisition of high-reliability parts.

Each of the above functions has been assigned to specific groups within the Section or to individuals reporting directly to the Section Manager. In some cases, the group assignments are further organized into task and subtask elements to attain improved coverage and overall Flight Project program control. This structure provides the means for better management control of the parts acquisition and delivery activity and feedback and status reporting from the Parts Program Managers and Parts Representatives to management.

5.3 SECTION ORGANIZATION

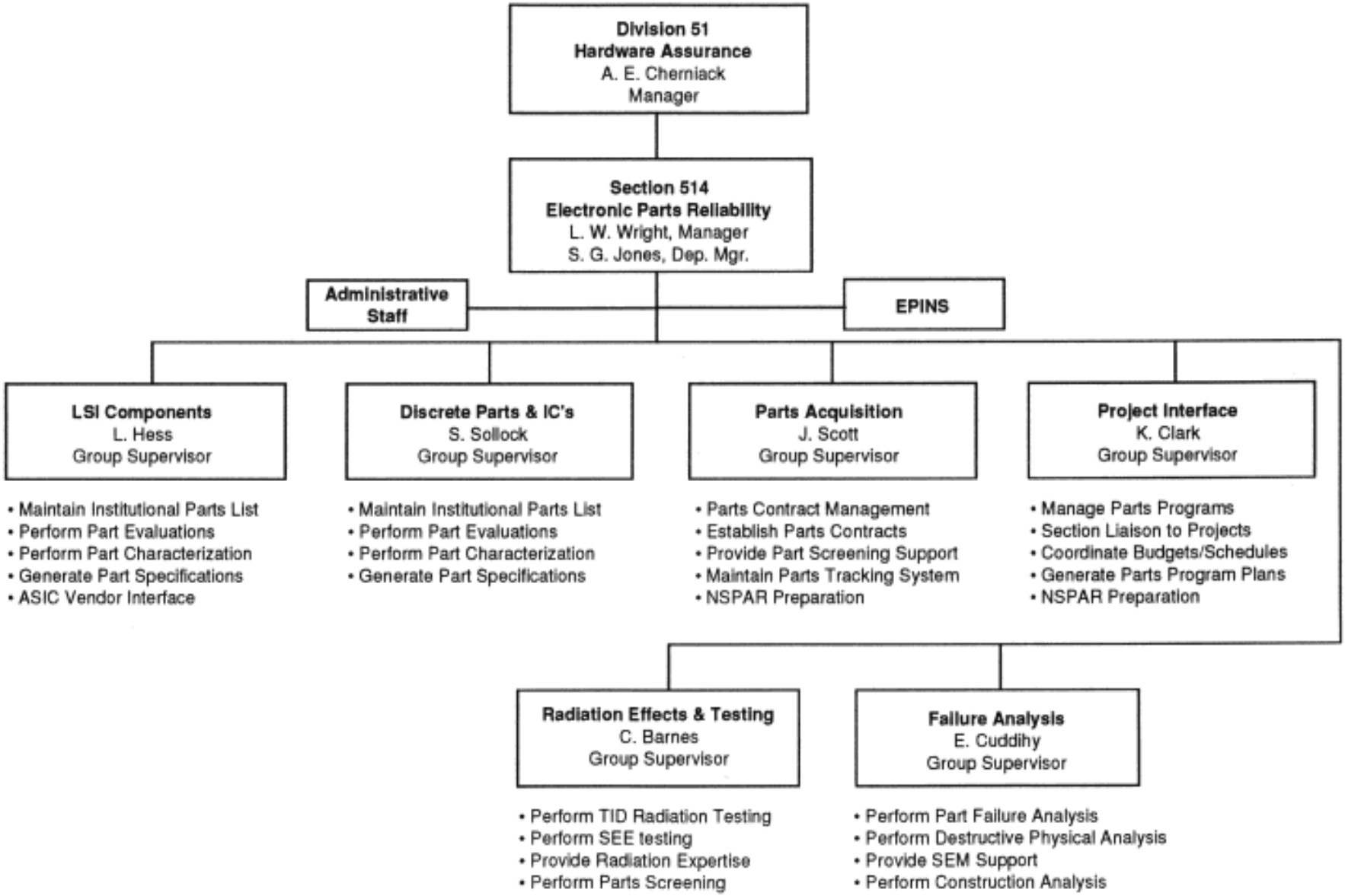
The general Section organization was shown in Figure 2.5. A summary of the major activities of each group is shown in Figure 5.1. A more detailed list of the major functions performed by members of the section is given below.

5.3.1 Section Staff

The following functions are performed by members of the Section staff:

- Development, management, and maintenance of the Electronic Parts Information Network System (EPINS).
- Coordination of the ALERT system for electronic and electromechanical parts.
- Accomplishment of various institutional administrative activities regarding personnel records, facilities, etc.

ELECTRONIC PARTS RELIABILITY



- Maintenance of Section financial database.

5.3.2 Discrete Components Group (5142)

The responsibilities of this group are to perform the following as they relate to discrete parts as well as SSI, MSI, and hybrid integrated circuits:

- Provide engineering support to JPL flight projects in (1) establishing requirements for selection, procurement, screening, and application of electronic parts; and (2) reviewing performance relative to these requirements.

- Establish and maintain the Laboratory Institutional Parts List (IPL) of controlled parts, including supporting specifications, application data, and evaluation data.

- Support the generation, maintenance, and control of APLs as required in support of Laboratory flight projects.

- Support the acquisition of flight-quality parts, as required, in support of Laboratory flight projects.

- Support the required screening and burn-in of electronic parts in-house or through contracts with industry, as appropriate.

- Support the Electronic Parts Information Network that will provide flight projects with status information on the progress of all aspects of their parts reliability program.

- Coordinate and implement JPL participation in the Government - Industry Data Exchange Program (GIDEP) and the NASA Alert System.

- Support Section participation in design reviews and material review board activities.

- Provide technical support for failure investigation and analysis of electronic parts.

- Support radiation tests, environmental measures, and data analysis of electronic parts.

- Perform characterization and evaluation on new parts technologies and test methodology.

- Support reliability parts stress analysis reviews.

- Support the coordination of standard parts specifications with NASA and the Department of Defense.

- Perform data review on procured parts

5.3.3 LSI Component Group (5141)

This group is responsible for the above listed responsibilities as they specifically relate to LSI, VLSI, and ASIC devices.

5.3.4 Failure Analysis Group (5145)

The responsibilities of the Failure Analysis Group are to:

- Provide the capability for in-depth investigation and analysis of failed electronic parts.
- Provide scanning electron microscope support to parts-oriented problems.
- Perform Destructive Physical Analysis (DPA) on electronic parts as part of JPL's overall qualification program for high-reliability electronic components and flight hardware.

5.3.5 Radiation Effects & Testing Group (5146)

The responsibilities of the Radiation Effects & Testing Group are divided among several subgroups as follows:

5.3.5.1 Single Event Effects / Testing Subgroup

- Provide radiation expertise support in matters pertaining to electronic parts.
- Provide parts radiation consultation support to parts users.
- Provide radiation information to support the IPL and APL.

5.3.5.2 Total Integrated Dose Testing Analysis Subgroup

- Provide radiation expertise support in matters pertaining to electronic parts.
- Provide parts radiation consultation support to parts users.
- Provide radiation information to support the IPL and APL.
- Operate and maintain the High Flux Radiation Facility (Gamma Ray) for support to parts-oriented problems.
- Operate and maintain the Low Dose Radiation Laboratory for support to parts-oriented problems.

5.3.5.3 Parts Characterization / Screening Subgroup

- Establish a capability for the screening and qualification of selected electronic parts.
- Provide engineering test support to parts related to R & D investigations.
- Operate and maintain the Electronic Parts Evaluation and Screening Laboratory.
- Provide engineering test support for the evaluation and qualification of selected electronic parts to validate acceptance for use in flight hardware design, build, and/or retrofit.
- Provide engineering test support for the qualification and evaluation of selected electronic parts for inclusion in the JPL IPL.

- Provide engineering test liaison and coordination with the agencies performing electronic parts screening and qualification testing.

5.3.6 Project Parts Interface Group (5144)

The responsibilities of the Project Parts Interface Group are to:

- Represent the Electronic Parts Reliability Section to designated flight projects and science instruments, including:

  (a) Providing the primary Section technical interface with the project offices and science instrument offices involving electronic parts.

  (b) Generating the Parts Program Requirements Document and the Parts Program Plan.

  (c) Generating operating plans that provide level-of-effort and schedules for the Section support to the flight projects.

  (d) Developing budget estimates and plans to assure timely completion of the Section support to the flight projects.

- Provide liaison between the Project /R&QA and the Section line operating elements to:

  (a) Ensure timely delivery of parts to project elements.

  (b) Develop status information on all aspects of Project parts acquisition and parts reliability programs.

  (c) Monitor and report status of achievements and problems.

5.3.7 Parts Acquisition Group (5143)

The responsibilities of the Parts Acquisition Group are to:

- Provide acquisition service support of designated flight projects and science instruments, including:

  (a) Initiate and coordinate placement of contracts and POs.

  (b) Oversee parts acquisition from identification of requirements through delivery to user.

  (c) Provide technical contract management.

- Coordinate the parts review activities
- Maintain the Parts Tracking System (PTS) within EPINS.
- Coordinate the Parts Pedigree System.

5.4 KEY PERSONNEL DESCRIPTIONS

The following is a list of the key technical personnel elements within the Section and a brief description of each job role.

5.4.1 Parts Program Manager

The Parts Program Manager, a member of the Part Interface Group, is the focus for coordination and management of all aspects of the parts program for a specific project. The principal responsibilities include:

- Liaison between Section 514 and the Project/design organizations.
- Monitoring and periodic status reporting of in-house, system / instrument contractor and subcontractor parts programs.
- Development of the Project Parts Program Plan and Project Approved Parts List.
- Development of contractor and subcontractor parts requirements.
- Development and monitoring of Section 514 plans and budgets.
- Coordination of all Section 514 support to Project and design activities.
- Informing the Project of all related parts activities outside of the Project.
- Presenting the Section 514 consolidated position on Project parts issues.

5.4.2 Parts Specialist

The Parts Specialists are members of the Discrete or LSI Components Group, as appropriate. The principal responsibilities of the Parts Specialists are:

- Develop, write, and negotiate the requirements and specifications for procurement, screening, and qualification.
- Review screening and acceptance test data.
- Review NSPARs and waivers.
- Review and rate project parts lists, parts documentation, and user applications.
- Perform surveys and surveillance of component vendors and test agencies.
- Maintain the Institutional Parts List.
- Plan, initiate, and direct parts qualification testing, evaluating, characterization and special test problems.
- Support construction analyses, failure analyses, and radiation testing.
- Provide consultation to all JPL and NASA users and JPL subcontractors.
- Perform/support device hardware and software analyses.

- Conduct R & AD tasks to support the above.
- Develop product assurance techniques applicable to advanced parts techniques.

A complete list of the Parts Specialist's duties and guidelines for his performance can be found in 51-G-01, *Parts Specialists Guidelines.* Table 5.2 lists the current Part Specialist along with their respective component expertise.

5.4.3 Failure Analyst

Failure Analyst are located in the Failure Analysis Group. The principal responsibilities of the Failure Analyst are:

- Verification of device failures.
- Performance of failure analysis and determination of the most probable cause of failure.
- Construction of failure model(s) of the failed device.

5.4.4 Parts Representative

The Parts Representatives, members of the Parts Acquisition Group, are responsible for all direct support activities, for a specific subsystem(s) / instrument(s), necessary to support the definition, acquisition, delivery and post-delivery support for electronic parts supplied to users. The principal responsibilities include:

- Interface with the design organization to determine parts needs.
- Establish and maintain electronic parts lists for Section 514 review, acquisition, traceability, etc.
- Coordinate component and radiation specialist reviews of parts lists.
- Coordinate procurement, screening, and demonstration specification development and review
- Assist design organization development of NSPARs / waivers and coordinate Section 514 review.
- Determine availability and sources of parts to meet Project needs.
- Perform tasks and coordinate reviews necessary to initiate procurement or transfer of flight parts.
- Monitor/track procurement/transfer and screen status of parts.
- Coordinate processing of parts through Project Stores and Electronic Parts Quality Assurance.
- Coordinate kitting of electronic parts to users.
- Coordinate failure analysis of failed electronic parts.

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TECHNICAL SPECIALISTS

Specialty Area	Specialist	
DISCRETE & IC GROUP		
Capacitors	Stern	47609
Crystals	Agarwal	45598
Diodes	Powell	40308
Electron Tubes	Powell	40308
Filters/Networks	Peden	41969
Fuses	Herin	40322
Inductors	Peden	41969
Microcircuits		
Digital Bipolar	Agarwal	45598
Digital MOS	Wilson	46246
Hybrid	Kayali	46830
Linear	Wilson	46246
Optoelectronics	Powell	40308
Oscillators	Agarwal	45598
Relays	Wilson	46246
Resistors/Networks	Herin	40322
Semiconductors	Powell	40308
Switches	Wilson	46246
Thermistors	Herin	40322
Transformers	Peden	41969
Transistors	Powell	40308
Failure Analysis	Cuddihy	43188
	Okuno	48625

Specialty Area	Specialist	
LSI GROUP		
ASICs	Rad	48368
Dig. Sig. Processor	Stott/	43070
	Grigorian	46581
Gate Arrays	Schafzahl	36693
	Stott/	45622
	Wall	44588
Memories	Schafzahl	36693
	Soliman	45622
Microprocessors	Grigorian	46581
FPGAs	Soliman	30309
PLDs	Schafzahl	36693
RISC Processor	Stott /	43070
	Wall	44588
Test Structures	Zahkaria /	43269
	Wall	44588
Sensors	Hancock	48801
CCD's	Hancock	48801
Radiation		
RADATA Databank	Farmanesh	41968
SEE	Nichols	45787
TID	Shaw	49560
Others		
Connectors	Dillon	48122
Wire and Cable	Section 352	48122

5.4.5 Procurement Coordinator

Procurement Coordinators are members of the Parts Acquisition Group. The principal responsibilities of the Procurement Coordinator are:

- Develop requisition to procure PASOed line items from the Parts Tracking System.
- Provide information to update the Parts Tracking System.
- Maintain records of procurement requisition.
- Assign a trace number to each line item of flight-part procurement.
- Provide follow up support of all procurements through purchasing until delivery from the distributor / manufacturer.
- Support the group in the Monthly Management Report (MMR) reporting effort as needed to report progress and problems.

5.4.6 Contract Technical Manager (CTM)

The CTMs are members of the Parts Acquisition Group. The principal responsibilities of the CTM are

- Participate in contract negotiations.
- Coordinate specification revision that correspond with negotiated agreements.
- Develop work order releases to meet project requirements.
- Set priorities at contractor facilities to expedite JPL's position in the production phase.
- Maintain detailed visibility of manufacturer's progress with special attention to yields and milestone schedules.
- Anticipate product-flow bottlenecks and other potential production hazards and the minimizing of same.
- Establish single-point contact with manufacturer's production effort.
- Develop Unilateral Modifications to contracts when necessary to meet system requirements.
- Interpret JPL drawings and procedures to manufacturer personnel and to JPL QA source inspectors and resolution of differences between manufacturer's QC and JPL QA.
- Assist with various review processes (electrical test data, SEM, etc.,).
- Interface with project Cognizant Engineers, Parts Specialists, and FA personnel to work out technical compromises that affect reliability and availability.
- Monitor and report to JPL management the progress and problems associated with

the manufacture of the product.

- Develop TDMs to document clarifications and interpretations of the contract and coordinate approval process with manufacturers representatives, Parts Specialists, and FA personnel.

- Participate in decisions regarding disposition of lot acceptance failures, including related NCMR, MRB, and waiver actions.

5.4.7 Screening Coordinator

The Screening Coordinator is a member of the Parts Acquisition Group. The principal responsibilities of the Screening Coordinator are:

- Coordinate with Parts Specialists and QA personnel to locate, qualifying, survey, and select commercial test laboratories with the capability to perform high-reliability testing in support of JPL flight programs.

- Monitoring the selected vendors to assure correct, complete, and timely fulfillment of the testing requirements.

- Coordinating the timely review and approval by Parts Specialists of vendor-authored screening test procedures.

5.4.8 Specification Coordinator

The Specification Coordinator is a member of the Parts Acquisition Group. The principal responsibilities of the Specification Coordinator are:

- Maintenance of the information in the specification tracking system in the Section computer network.

- Maintenance of the sample templates and boilerplate for specifications in the Section computer network.

- Coordinating the timely review and approval by Parts Specialists of specifications.

5.4.9 Global File Administrator

An administrator is designated for each EPINS file in the Global File System (GFS). The principal responsibilities of a Global File Administrator are:

- Ensure the integrity of the data and to ensure that discrepancies are corrected and that new entries are properly and expeditiously entered.

6.0 PARTS PROGRAM MANAGEMENT

6.1 INTRODUCTION

The following paragraphs detail some of the specific management responsibilities and duties along with the implementation approach. Some of the discussion also concerns other Sections within Division 51. In addition some emphasis is given to the dissemination and exchange of information to organizations outside of Section 514.

6.2 REQUIREMENTS

6.2.1 Parts Program Requirements (PPR)

The primary document governing the management of the parts programs for individual flight projects and science instruments is the Parts Program Requirements (PPR). The PPR defines the minimum parts program requirements for the individual mission hardware based upon the designated mission classification. Each Parts Program is a Project document and is project specific. JPL D-5357, *Electronic Parts Program Requirements for Flight Payloads,* requires that all hardware supplied to sponsors use the highest quality electronic and electromechanical parts consistent with the mission payload classification. This document defines all parts program policies and requirements and their applicability to organizations both within and external to JPL.

Deviations from the requirements established in D-5357 are permitted only after a formal waiver has been prepared, reviewed, and approved by the Cognizant Program or Project Manager.

6.2.2 Parts Program Plan (PPP)

Each organization responsible for implementing a parts program is required to create a Parts Program Plan (PPP). This plan defines the measures to be employed to assure compliance with the requirements of the PPR. The PPP documents how the implementation of the PPR is to be accomplished. The PPR indicates what is to be done; and the PPP indicates how the PPR will be accomplished. The PPP should indicate what hardware is affected, the overall parts organization that will implement the parts program, the implementation plan and procedures for satisfying each PPR requirement, and in the case of contractors, how it will be reported to JPL.

6.3 RESPONSIBILITIES

The Section's electronic parts responsibilities for each specific project are negotiated with each individual project and are contained in the respective Project's Part Program Plan prepared by the Section.

6.3.1 JPL-Built Hardware

Listed below are the general tasks that are performed by the Section in support of hardware built by JPL technical Divisions. These consist of all activities necessary to manage and support the electronic parts program, including:

- Preparation and maintenance of the Project's Approved Parts List, Parts Program

Requirements, and Parts Program Plan. This includes assisting designers in selecting the most reliable parts for their needs and reviewing subsystem parts lists for acceptability and recommendations. This also includes reviewing subsystem electronic parts requirements for the Project's radiation acceptability.

- Management of all engineering and acquisition-related activities associated with the Project's electronic parts, and supporting reviews and monthly management meetings in order to assess the status of the parts activities.

- Performance of parts reviews, waiver review / disposition, and parts specialists consultations.

- Preparation of all specifications required to procure, test, and screen all of the electronic Project's engineering and flight model electronic parts. This includes the generation of any specifications, test, and screening documentation required.

- Procurement of all flight and engineering model electronic parts, including the purchase of parts anticipated for use for which specific requirements may not be defined (anticipatory buy). This includes responsibility for the ultimate delivery of the parts to the subsystems for fabrication within an agreed an upon budget and schedule.

- Performance of DPAs, failure analyses, and part problem resolution in support of the Project's electronic parts. This includes providing comprehensive analysis of all failed electronic parts submitted by the subsystems and the development of failure analysis tools for new technology.

- The generation of stress analysis guidelines.

- Providing consultation on the requirements necessary to qualify advanced technology parts for use by the project.

- Providing Technical Contract Management for all electronic parts related contracts.

- Responsibility for performance of all screening (both in-house and at vendors) and verification of all screening.

- Performing Total Ionizing Dose (TID), Single Event Effect (SEE) verification, and other special testing as necessary.

- For Application Specific Integrated Circuits (ASIC) and other special devices, provide the following as appropriate:

  (a) Provide necessary technical and procurement documentation, technical contract management, and review of vendor data required to procure the product(s).

  (b) Qualify the vendor's process and fabrication line through on-site audit and physical and electrical characterization of the product(s).

  (c) Qualify the JPL standard cell library for fabrication by the selected vendor.

  (d) Qualify the overall product design through simulation and computer verification of layout geometry. Design qualification includes development of a test vector set and review of that set for completeness.

(e) Provide for qualification of the product(s) including the development of an Advantest test program for the characterization of the product(s).

6.3.2 Contractor-Built Hardware

Listed below are the minimum tasks that should be performed by the Section in support of hardware built by JPL contractors:

- Provide monitoring of the contractor's parts activities, including:

  (a) Perform review of the contractor generated Parts Program Plan

  (b) Supporting reviews and monthly management meetings in order to assess the status of the parts activities and to provide an independent assessment of the adequacy of the contractors parts program.

  (c) Performing reviews of contractor generated NSPARs and waivers and informing the Projects of any significant problems that may result.

  (d) Performing DPAs and failure analyses, as required, on selected parts.

  (e) Acquainting the Project with significant parts-related problems that may affect their subsystems.

The major management tools used by the Section to assure performance of the above tasks are summarized on the matrix shown in Figure 6.1. They tools will be explored further in the following sections.

6.4 KEY INTERFACES

The Section interfaces with a wide variety of groups in the implementation of a parts program. These complex interfaces are shown on the matrix in Figure 6.2. The following paragraphs will explore these varies interfaces and the nature of the relationship to the Section. interrelationship and interfaces between the internal Section support activities will not be addressed specifically in the section as they are dispersed through this document.

6.4.1 Advisory Groups

Division 51 and the Section maintains several advisory groups to aid the Section in the performance of its tasks. These groups are described below.

6.4.1.1 Electronic Parts Program Standing Review Board

The Assistant Director of the Office of Engineering and Review periodically convenes an Ad-Hoc Review Board to "Provide a programmatic input to the (JPL) electronic parts program in particular, including a focus of observation and recommendations from the user community." The members of the Board are advisors to and appointed by the ALD, Office of Engineering and Review.

6.4.1.2 Electronic Parts Advisory Group (EPAG)

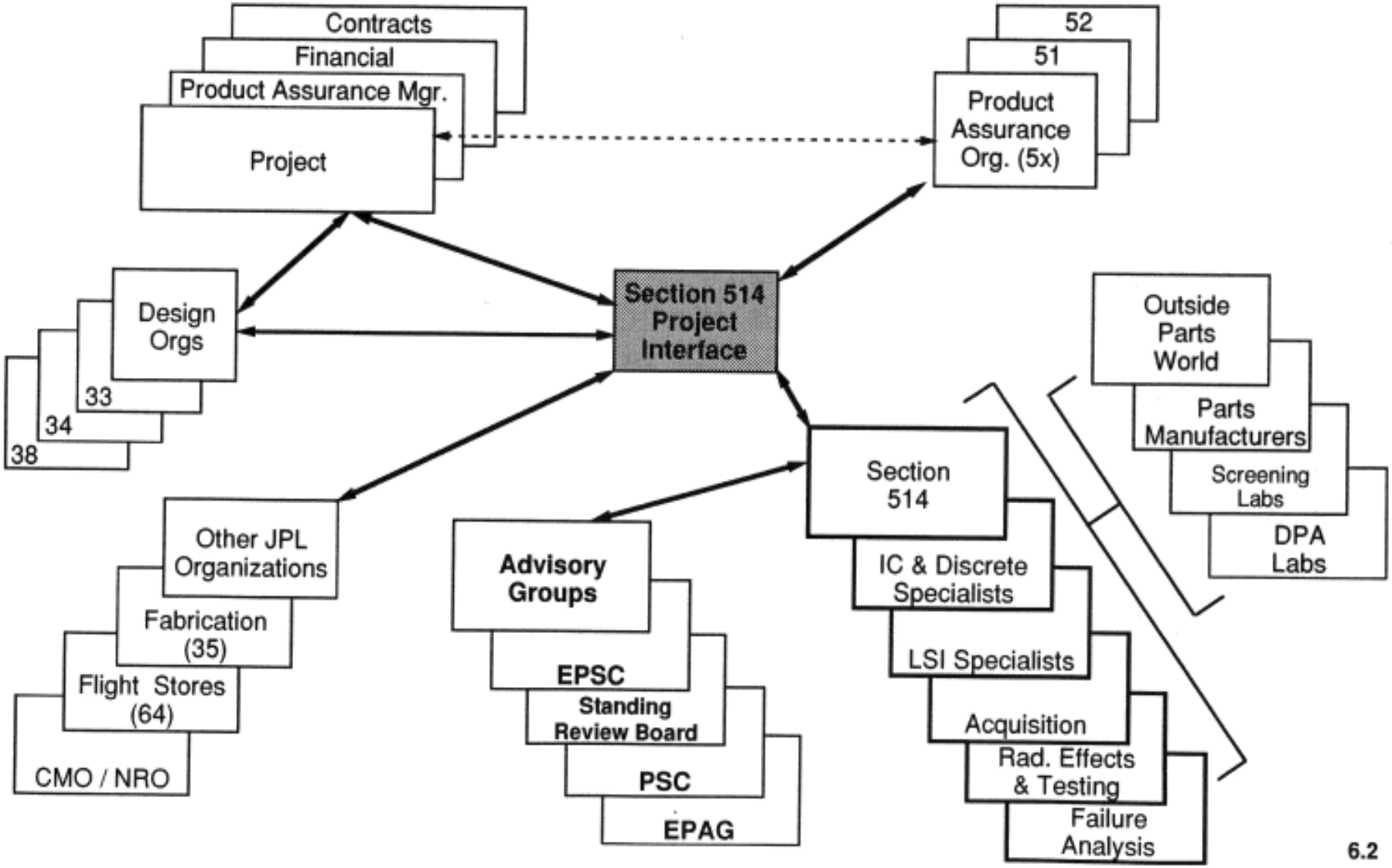
The EPAG is an advisory group to the Section. Its primary function was delineated in

PARTS PROGRAM MANAGEMENT

Parts Program Element \ Mgmt Tool	Monthly Management Reviews	Parts Steering Committee	Nominal Interfaces	SRMs / RSRs	EPINS					
					Timecard & Cost Estimates	Work Orders	Liens	Action Items	Electronic Parts Lists	Parts Tracking
1) Technical - Issues / Solutions - Reqmts Compliance										
2) Cost										
3) Schedule										

ELECTRONIC PARTS RELIABILITY

PARTS PROGRAM INTERFACES



Section 2. The current composition is given on Figure 6.3.

The primary responsibilities of the EPAG are to:

- Anticipate JPL Project requirements for the next 3-5 years and identify the minimal set of specific electronic part types that could be reasonably used to accomplish the design of the spacecraft electronics. Where practicable, emphasis should be given to the selection of part types that not only have adequate electrical performance but have been demonstrated to have suitable reliability and radiation characteristics.

- For part types that are needed but have not been proven to meet the reliability or radiation requirements for spacecraft use, estimate the cost of evaluating them and recommend the priority order in which they should be evaluated.

- Recommend part types for inclusion in the JPL Institutional Parts List and further recommend for which of these types JPL should maintain a flight-quality stock.

- Advocate that spacecraft electronic designs be accomplished only with parts included in the Institutional Parts List, with emphasis on those types for which JPL maintains a flight-quality stock.

- Continuously review future spacecraft project requirements and the trends in electronic parts technology as compared to the capability of the part types in the Institutional Parts List. Recommend when types should be replaced by ones of newer technology because they either no longer satisfy the needs or are becoming obsolete.

6.4.1.3 Parts Steering Committee(s)

For selected programs, the appropriate Project Manager, in consultation with Section 514, will appoint a Parts Steering Committee. The committee has a chairman designated by Section 514. The membership will consist of representatives of all the Project subsystems using parts to be supplied by the Section. The purpose of the committee will be to:

- Identify the minimum set of part types necessary to implement the project hardware (including inherited designs).

- Investigate the qualification/evaluation status of each of these part types.

- Determine the total dose (SEU) sensitivity of the required semiconductor devices.

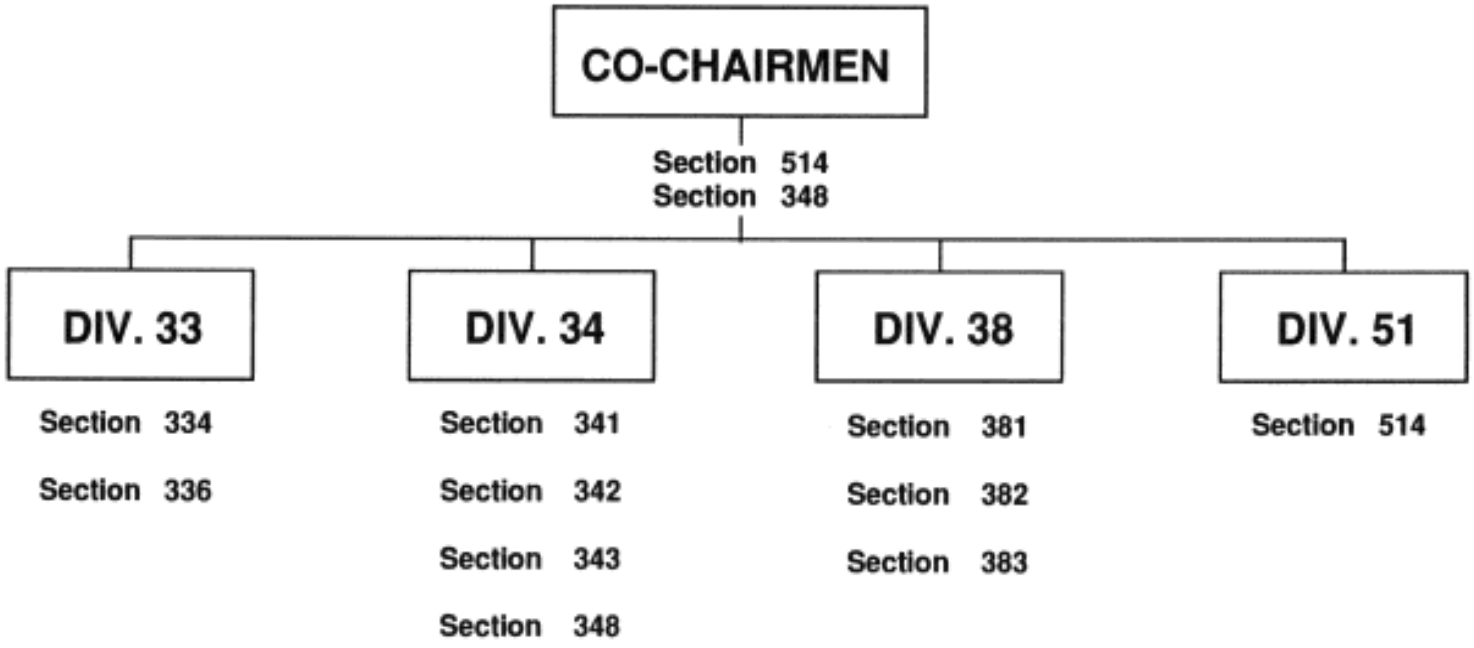
- Determine whether an acceptable procurement specification and approach exists for each of the required part types.

- Identify, with respect to the items above, any part types for which it appears that the Project will have to expend funds to achieve an acceptable position.

6.4.2 Projects

TBD

ELECTRONIC PARTS ADVISORY GROUP (EPAG)



6.4.3 Design Organizations

T B D

6.4.4 Other OER (5X) Organizations

T B D

6.4.5 Other Outside (Non-JPL) Parts Organizations

T B D

Figure 6.4 depicts, in a generalized way, the major elements of all of the Product Assurance activities in support of an in-house project; together with their relationships to significant project events. Specific activities and documents affecting this flow are indicated by circled numbers. These numbered activities are defined in Figures 6.5. Figures 6.5 displays the elements of an in-house parts reliability program in detail together with the interactions between the participating organizations. The specific role of Section 514 in the total reliability activity is highlighted by the shaded areas of Figure 6.5. Figures 6.6 and 6.7 shows the corresponding events and activities for system contracted programs.

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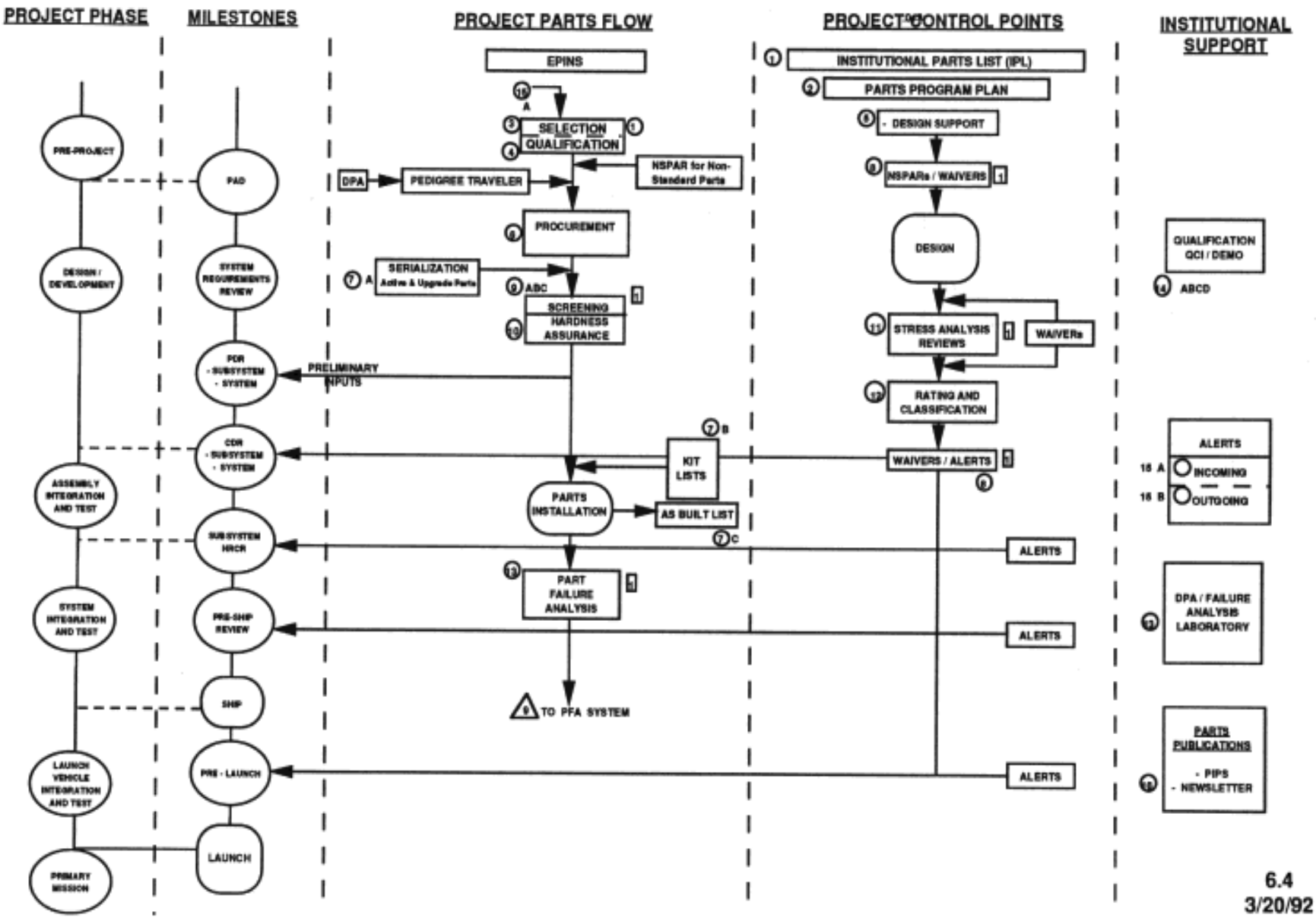
RELIABILITY ASSURANCE ACTIVITIES - JPL - IN HOUSE PROJECT



ELECTRONIC PARTS RELIABILITY

RELIABILITY ASSURANCE ACTIVITIES - JPL - IN HOUSE PROJECT

ORGANIZATIONAL ELEMENTS / RELIABILITY TASK ELEMENTS		PARTICIPATING ORGANIZATIONS																																				
		PROJECT OFFICE				TECHNICAL DIVISION					CONTRACTOR				ADMINISTRATIVE DIV.				QUALITY ASSURANCE & RELIABILITY																				
				STAFF																																				
		PROJECT MANAGER	S/C SYSTEM MANAGER	PROGRAM SAFETY	RELIABILITY AND Q.A.	SUBSYSTEM TECHN MGR	DESIGN AGENCY	TECH SUPT REPR - 30	ANYONE	DESIGN AGENCY REP SUBCONTR	QUALIF. TEST AGENCY				INSTITUTIONAL SAFETY	PROCUREMENT			QA & R OFFICE MANAGER	ELECT PARTS REL SECT MGR	R&D & PARTS TST GRP-514	PARTS ENGRNG GROUP - 514	PARTS I/F GROUP - 514	ALERT REPR	FA GROUP - 514 GRP	PARTS ACQ. GROUP - 514					RELIABILITY ENG SERV -321	QUALITY ASSURANCE	
①	INSTITUTIONAL PARTS LIST (IPL)						S												M	A		P															
②	PARTS PROGRAM PLAN [1] (INCL. APPROVED PARTS LIST)		A		A		R	S [6]											M			S	P														
③	SELECTION [1] [3]		A		R	R	P *			P *											R	R	S	R	S	M					M						
④	QUALIFICATION-SELECTION: PROJECT		A		R														M	R	P	P	S	S		M											
⑤	DESIGN SUPPORT						P														S	S	S	S	S												
⑥	PROCUREMENT [3]		A		R											S				R	S	S	P		S											S	
⑦A	TRACEABILITY — PEDIGREE TRAVELER																						M			P										P	
⑦B	TRACEABILITY — SERIALIZATION (Active & Upgrade Parts)																						P			S										M	
⑦C	TRACEABILITY — KIT LISTS					P																	S			S										M	
⑦D	TRACEABILITY — AS BUILT LIST [3]					P																				S										M	

CODE:
P = PRIMARY
S = SECONDARY
M = MONITOR
R = REVIEW
A = APPROVE

1 DATA SUMITTAL REQUIRED
2 MONTHLY PMP MEETINGS REQUIRED
3 SIMILAR METHODOLOGY EXISTS FOR ALL NON-ELECTRICAL PMP
* FUNCTION CAN BE IN EITHER OR ALL ORGANIZATIONS

A = THE PROJECT AND S/C SYSTEM MANAGERS APPROVALS ARE ALWAYS THE AUTHORIZING APPROVALS FOR PROGRAM IMPLEMENTATION. LINE MANAGEMENT APPROVAL IMPLIES CONCURRENCE, COMMITTMENT, AGREEMENT

ELECTRONIC PARTS RELIABILITY

RELIABILITY ASSURANCE ACTIVITIES - JPL - IN HOUSE PROJECT

RELIABILITY TASK ELEMENTS / ORGANIZATIONAL ELEMENTS		PARTICIPATING ORGANIZATIONS																																
		PROJECT OFFICE				TECHNICAL DIVISION					CONTRACTOR				ADMINISTRATIVE DIV.				QUALITY ASSURANCE & RELIABILITY																
		PROJECT MANAGER	S/C SYSTEM MANAGER	STAFF: PROGRAM SAFETY	STAFF: RELIABILITY AND Q.A.	SUBSYSTEM TECH'N MGR	DESIGN AGENCY	TECH SUPT REPR - 96	ANYONE	DESIGN AGENCY REP SUBCONTR	QUALIF. TEST AGENCY				INSTITUTIONAL SAFETY	PROCUREMENT			QA & R OFFICE MANAGER	ELECT PARTS REL SECT MGR	RAD & PARTS TST GRP-514	PARTS ENGRNG GROUP - 514	PARTS IF GROUP - 514	ALERT REPR	PA GROUP - 514	PARTS ACQ. GROUP - 514									
⑧	NSPARs / WAIVERs [1] [3]		A		M	A	P	A [6]													A	A [7]	M			M							
⑨ A	SCREENING — SPECIFICATION PREPARATION / APPROVAL [1]						S [6]									S [6]				M	S	A [10] P	S			S							
⑨ B	SCREENING — TESTING: IN-HOUSE				M															M	P	A	S			M							M
⑨ C	SCREENING — TESTING: MANUFACTURING				M																	A	S			P							M
⑩	HARDNESS ASSURANCE						S			S											P	S	S										
⑪	STRESS ANALYSIS REVIEW [1]		M		R	R	P *			P *												P	S			M							P
⑫	RATING AND CLASSIFICATION [3]		M		R	R	S			S										M	S	P	S										M
⑬	PART FAILURE ANALYSIS [1]				M	S	P *			P *										M		S	M	S	P	M							A	S

CODE:
- P = PRIMARY
- S = SECONDARY
- M = MONITOR
- R = REVIEW
- A = APPROVE

1 DESIGN AGENCY DATA SUBMITTAL REQUIRED
3 SIMILAR METHODOLOGY EXISTS FOR ALL NON-ELECTRICAL PMP
6 AS REQUIRED
7 FOR ELECTRONIC PARTS
8 FOR ALL NON-ELECTRICAL PMP ITEMS
* FUNCTION CAN BE IN EITHER OR ALL ORGANIZATIONS

A = THE PROJECT AND S/C SYSTEM MANAGERS APPROVALS ARE ALWAYS THE AUTHORIZING APPROVALS FOR PROGRAM IMPLEMENTATION. LINE MANAGEMENT APPROVAL IMPLIES CONCURRENCE, COMMITTMENT, AGREEMENT

ELECTRONIC PARTS RELIABILITY

RELIABILITY ASSURANCE ACTIVITIES - JPL - IN HOUSE PROJECT

Ref.	Reliability Task Elements		Project Office: Project Manager	Project Office: S/C System Manager	Project Office (Staff): Program Safety	Project Office (Staff): Reliability and Q.A.	Technical Division: Subsystem Techn Mgr	Technical Division: Design Agency	Technical Division: Tech Supt Repr - 35	Technical Division: Anyone	Technical Division: Design Agency Rep Subcontr	Contractor: Qualif. Test Agency	Contractor	Contractor	Administrative Div.: Institutional Safety	Administrative Div.: Procurement	Administrative Div.	Administrative Div.	QA&R: QA & R Office Manager	QA&R: Elect Parts Rel Sect Mgr	QA&R: Rad & Parts Test Grp 514	QA&R: Parts Engrg Group - 514	QA&R: Parts I/F Group - 514	QA&R: Alert Repr	QA&R: F.A. Group - 514	QA&R: Parts Acq. Group - 514	QA&R	QA&R	QA&R	QA&R	QA&R: Reliability Eng Serv 521	QA&R: Quality Assurance
(14) A	QUALIFICATION	SELECTION: INSTITUTIONAL						S								S			M	A		A [10] P	S									
(14) B	QUALIFICATION	SPECIFICATION PREPARATION																		M	S [6]	A [10] P				S						
(14) C	QUALIFICATION	TESTING: IN-HOUSE																			P	A				P						
(14) D	QUALIFICATION	TESTING: CONTRACTOR										S									P	A										
(15) A	ALERTS	INCOMING			S	R	R	R	R [5]						S							S		P		M					S	
(15) B	ALERTS	OUTGOING			S	R	R	R	R	S					S				M	A		S		P		M						
(16) B	PARTS PUBLICATIONS					M		M												M		P										
[1]	DATA SUBMITTAL					M	M	P *	A [8]		P *										S	A [7]	S								M	
[2]	MONTHLY MMR MEETINGS			M		P	S		S										M		S	S	P			S					M	S

CODE:
P = PRIMARY
S = SECONDARY
M = MONITOR
R = REVIEW
A = APPROVE

3 SIMILAR METHODOLOGY EXISTS FOR ALL NON-ELECTRICALPM
6 AS REQUIRED
7 FOR ELECTRONIC PARTS
8 FOR ALL NON-ELECTRICAL PMP ITEMS
9 PRE-PROJECT MANAGER
10 GROUP SUPERVISOR
* FUNCTION CAN BE IN EITHER OR ALL ORGANIZATIONS

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ELECTRONIC PARTS RELIABILITY

RELIABILITY ASSURANCE ACTIVITIES - SYSTEM CONTRACT MODE

TO BE COMPLETED

ELECTRONIC PARTS RELIABILITY

RELIABILITY ASSURANCE ACTIVITIES - SYSTEM CONTRACT MODE

ORGANIZATIONAL ELEMENTS / RELIABILITY TASK ELEMENTS	PARTICIPATING ORGANIZATIONS																																			
	PROJECT OFFICE				TECHNICAL DIVISION					SYSTEM CONTRACTOR							QUALITY ASSURANCE & RELIABILITY																			
			STAFF																																			
	PROJECT MANAGER	S/C SYSTEM MANAGER		RELIABILITY AND Q.A.	SUBSYSTEM TECHN MGR		TECH SUPT REPR - 38				PROJECT (STR)							QA & R OFFICE MANAGER	ELECT PARTS REL SECT MGR		RAD & PARTS TST GRP-514	PARTS ENGRNG GROUP - 514	PARTS MF GROUP - 514		FA GROUP - 514							RELIABILITY ENG SERV -321	QUALITY ASSURANCE	
NSPARs / WAIVERs [1] [3]		A		M	A		[6]				P										A	A	S									M		
SCREENING-SPECIFICATIONS PREPARATION / APPROVAL [3]											P										[6] S	[6] A	S											
SCREENING-TESTING: IN-HOUSE											P											[6] M											[6] M	
SCREENING-TESTING: MANUFACTURER											P																						[6] M	
HARDNESS ASSURANCE											P										M													
STRESS ANALYSIS REVIEW [1]				M	M						P											M	S									A		
RATING AND CLASSIFICATION [6]				R	R						P											[6] M												
PART FAILURE ANALYSIS [1]		M		R	R						P														R							A		

CODE:
- P = PRIMARY
- S = SECONDARY
- M = MONITOR
- R = REVIEW
- A = APPROVE

1 DESIGN AGENCY DATA SUBMITTAL REQUIRED
3 SIMILAR METHODOLOGY EXISTS FOR ALL NON-ELECTRICAL PMP
6 AS REQUIRED
6 FOR ALL NON-ELECTRICAL PMP ITEMS

A = THE PROJECT AND S/C SYSTEM MANAGERS APPROVALS ARE ALWAYS THE AUTHORIZING APPROVALS FOR PROGRAM IMPLEMENTATION. LINE MANAGEMENT APPROVAL IMPLIES CONCURRENCE, COMMITTMENT, AGREEMENT

ELECTRONIC PARTS RELIABILITY

RELIABILITY ASSURANCE ACTIVITIES - SYSTEM CONTRACT MODE

PARTICIPATING ORGANIZATIONS

ORGANIZATIONAL ELEMENTS / RELIABILITY TASK ELEMENTS	PROJECT OFFICE				TECHNICAL DIVISION					SYSTEM CONTRACTOR							QUALITY ASSURANCE & RELIABILITY													
			STAFF																											
	PROJECT MANAGER	S/C SYSTEM MANAGER		RELIABILITY AND Q.A.	SUBSYSTEM TECHN MGR		TECH SUPT REPR - 35				PROJECT (CTR)						QA & R OFFICE MANAGER	ELECT PARTS REL SECT MGR	RAD & PARTS TST GRP-514	PARTS ENGRNG GROUP - 514	PARTS IF GROUP - 514		FA GROUP - 514 GRP						RELIABILITY ENG SERV 521	QUALITY ASSURANCE
PARTS PROGRAM PLAN (INCL. APPROVED PARTS LIST) [1]		A		A			R [6]				P						M	M	R	R	A		R							
SELECTION [1] [3]		A		R	R		R [6]				P								R	R	A									
DESIGN SUPPORT					M						P										M									
PROCUREMENT [3]				M			M [6]				P										M									M
TRACEABILITY: SERIALIZATION											P										M									M
TRACEABILITY: KIT LISTS											P										M									
TRACEABILITY: AS BUILT LIST [3]											P										M									M

CODE:
- P = PRIMARY
- S = SECONDARY
- M = MONITOR
- R = REVIEW
- A = APPROVE

1 DATA SUBMITTAL REQUIRED
3 SIMILAR METHODOLOGY EXISTS FOR ALL NON-ELECTRICAL PMP
6 FOR ALL NON-ELECTRICAL PMP ITEMS

A = THE PROJECT AND S/C SYSTEM MANAGERS APPROVALS ARE ALWAYS THE AUTHORIZING APPROVALS FOR PROGRAM IMPLEMENTATION. LINE MANAGEMENT APPROVAL IMPLIES CONCURRENCE, COMMITTMENT, AGREEMENT

ELECTRONIC PARTS RELIABILITY

RELIABILITY ASSURANCE ACTIVITIES - SYSTEM CONTRACT MODE

		PARTICIPATING ORGANIZATIONS																													
ORGANIZATIONAL ELEMENTS / RELIABILITY TASK ELEMENTS		PROJECT OFFICE				TECHNICAL DIVISION					SYSTEM CONTRACTOR							QUALITY ASSURANCE & RELIABILITY													
		PROJECT MANAGER	S/C SYSTEM MANAGER	STAFF	STAFF: RELIABILITY AND Q.A.	SUBSYSTEM TECHN MGR		TECH. SUPT REPR - 36				PROJECT (CTR)						QA & R OFFICE MANAGER	ELECT PARTS REL SECT MGR	RAD & PARTS TEST GRP-514	PARTS ENGRNG GROUP - 514	PARTS VF GROUP - 514		FA GROUP - 514						RELIABILITY ENG SERV -521	QUALITY ASSURANCE
QUALIFICATION	SELECTION:		A		R	R						P								R	R	S									
QUALIFICATION	SPECIFICATION PREPARATION											P								A	A										
QUALIFICATION	TESTING: IN-HOUSE											P								M	M										
QUALIFICATION	TESTING: CONTRACTOR											P									M										
ALERTS	INCOMING				M			S #				P									S									S	
ALERTS	OUTGOING				M			M #	S			P									M										

CODE:
- P = PRIMARY
- S = SECONDARY
- M = MONITOR
- R = REVIEW
- A = APPROVE

\# FOR ALL NON-ELECTRICAL PMP ITEMS

A = THE PROJECT AND S/C SYSTEM MANAGERS APPROVALS ARE ALWAYS THE AUTHORIZING APPROVALS FOR PROGRAM IMPLEMENTATION. LINE MANAGEMENT APPROVAL IMPLIES CONCURRENCE, COMMITTMENT, AGREEMENT

6.5 PARTS PROGRAM MANAGER

The primary management of the Parts Program Plan is through the Parts Program Manager. Section 514 appoints a Parts Program Manager to manage and coordinate all aspects of the Section 514 parts support effort to each Project. The specific responsibilities of the Parts Program Manager are delineated in paragraph 5.4.1.

The primary means of reporting the status of all parts programs is the Monthly Management Report (MMR). The purpose of the MMR is to facilitate more effective management of Section 514 parts program commitments. The specific thrust of the reports is:

- To more effectively communicate the current technical performance status of flight parts activities, including parts lists, NSPARs, waivers, procurements, screening, qualification, and delivery.
- To indicate the current budgetary status of the parts program.
- To indicate areas where additional assistance of the Project / Program may be required.

These reports are intended to ensure that the users have timely information on all electronic parts-related issues that may entail technical, schedule, or budgetary risk and aid in the more effective management of Section 514 resources.

For some major/critical tasks, the reports are supplemented by the addition of monthly management reviews held with the appropriate Project / design personnel.

6.6 ELECTRONIC PARTS INFORMATION NETWORK (EPINS)

The primary mechanism used to status the overall Section parts program activities is EPINS. EPINS is compose of a set of integrated software application programs and associated system software and hardware. The system's purpose is to provide a Laboratory-wide, centralized, updated information source on electronic parts.

The system hardware architecture is shown in Figure 6.8. A conceptual diagram of the major system software components is shown in Figure 6.9. These major characteristics and components of the system are described below. A more comprehensive description of EPINS is contained in document 51-EPN-EIP-001, *Status and Plans for Electronic Parts Information Network System (EPINS)* and 51-EPN-SYS-ARC-001, *EPINS Hardware & System Software Description.*

6.6.1 Network Configuration

The current EPINS network has direct connections in approximately 7 buildings on the Laboratory via an Ethernet cabling system. Approximately 150 users are directly connected to the network, with approximately 80 active connections at any one time.

The EPINS network utilizes three Novell file servers: two 486/33Mhz EISA servers and one 486/50Mhz EISA server. The current network configuration is approximately 85% Ethernet, and 15% TokenRing, with a small Appletalk network to support Mac users within Section 514.

EPINS has approximately 15 shared printers attached to the network. There is approximately 4 gigabytes of tape backup capacity for backing up the 5.5 gigabytes of network disk

capacity. Sixteen dedicated 386/33 MHz computers have been setup to support remote users accessing EPINS either by modem or the low speed ILAN channel. EPINS also supports 6 low speed ILAN connections and two 9600 baud modems for outgoing communication from the network. A cisco gateway provides connection to Channel 3P on the high speed ILAN. This gateway is also shared by two other Novell networks in Building 303.

EPINS Network Conceptual Topology

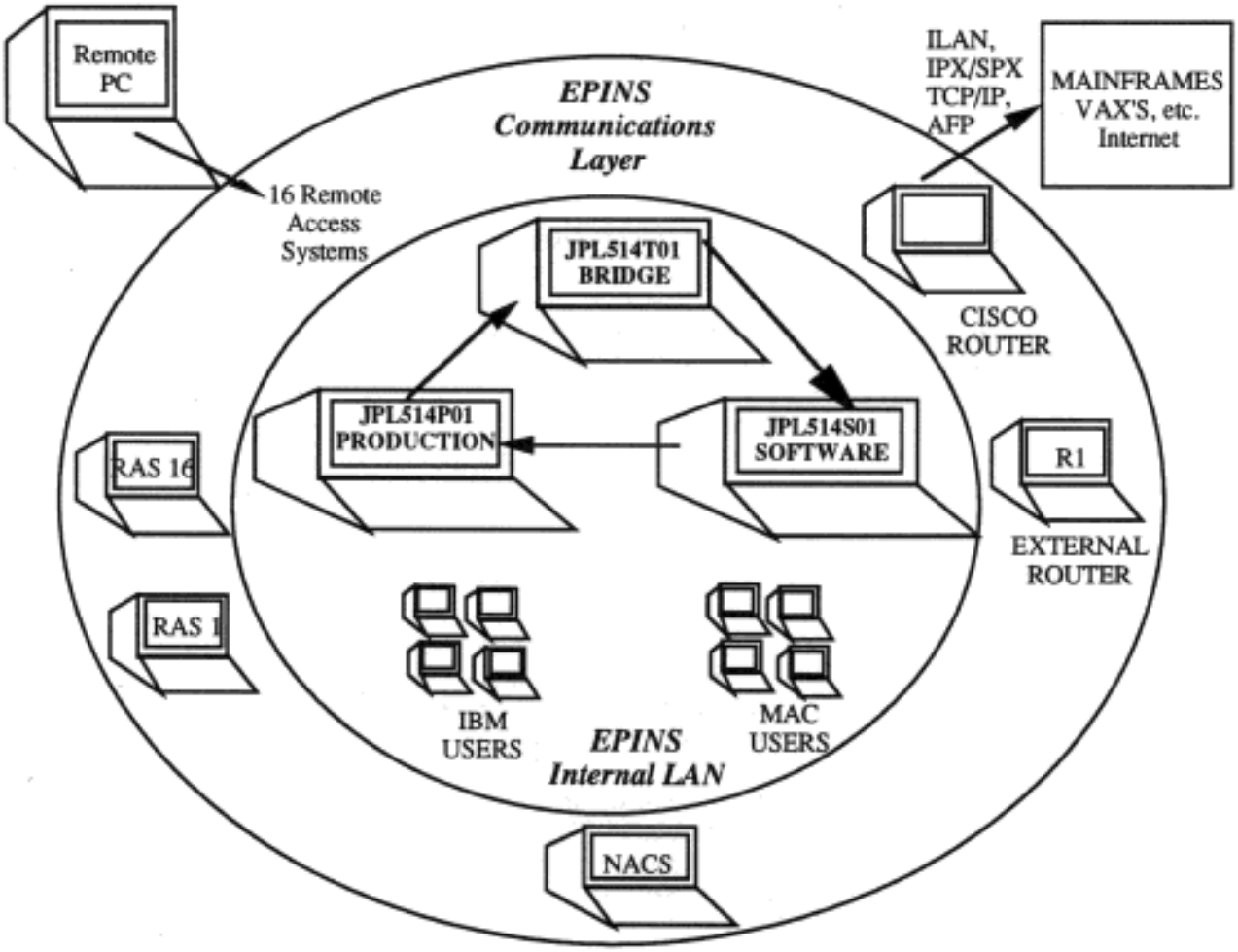


Figure 6.8

Legend

Software.	Software Server used by EPINS programmers to develop and test applications
Bridge	Bridging Server used by EPINS to interconnect buildings 125, 300, 171, and 241
Production.	Production Server accessed by all IBM, MACS, and remote users
NACS.	NetWare Asynchronous Communication Server (NACS) providing outgoing modem and ILAN connections from EPINS
cisco.	High Speed ILAN access router (IPX, AFP, TCP/IP protocols)
R1	Building 303 external bridge router (TokenRing, Ethernet)
RAS1..RAS16	Remote Access Systems consisting of 386 PCs w/9600 baud modems or low speed ILAN for remote connection to EPINS

EPINS Interfaces

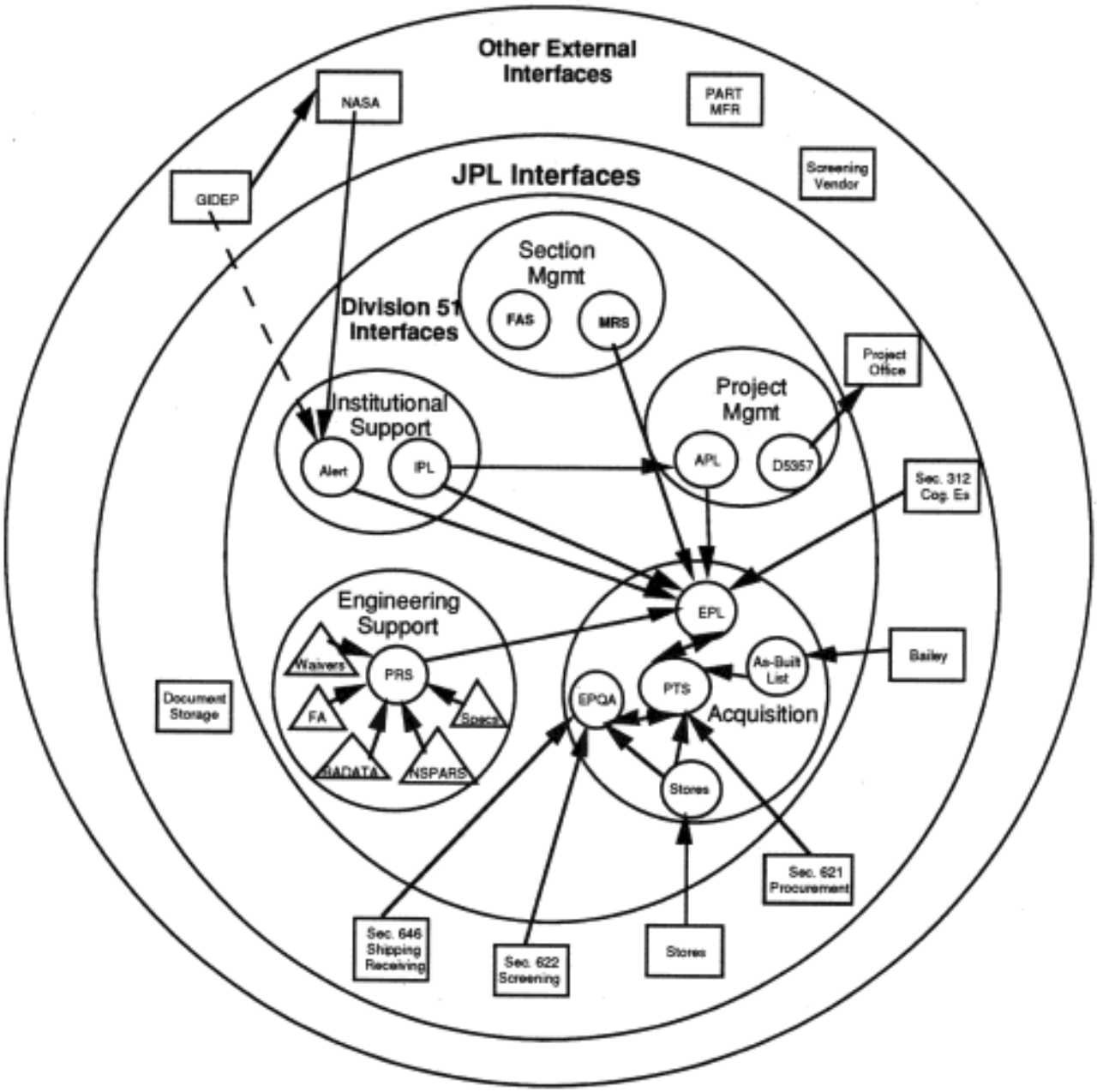


Figure 6.9

6.6.2 Workstations

The EPINS system is currency being written for machines running in a DOS environment with hardware and software incorporated into the network to allow locally connected Mac users to run the EPINS DOS based applications. Some limited use is made of Windows based

applications. However, the use of such applications within EPINS is being restricted until such time as such applications can be operated by Mac users. This hardware and software could be adapted to remote Mac users coming in over either modem or low speed ILAN. EPINS also supports Macs with a direct Ethernet connection running SoftPC or SoftAT and SoftNode. These software products allow a Mac to emulate an Intel 8088 or 80286, and a Novell Ethernet connection in order to execute DOS based software and to access a Novell file server as a DOS based machine. At present, EPINS does not directly support UNIX based systems. Little resources have been devoted to determining precisely how UNIX based systems could execute the EPINS DOS based software. To date, UNIX systems can run DOS software locally, but are unable to attach to a Novell file server as a DOS based work station (only as a UNIX based system). It is anticipated that a solution will eventually become available. The company that developed the Macintosh products currently has a SoftPC product for UNIX and is working on a SoftNode product.

6.6.3 Application Software Description

The overall application software system architecture is shown in Figure 6.9. When completed, the various application programs will have the basic characteristics detailed below.

6.6.3.1 Institutional Parts List (IPL) System / Approved Parts List

The IPL system interfaces to all other EPINS systems through the Electronic Parts List (EPL) system. It is used to maintain a reference data base of parts that can be used for the creation of APLs or parts lists. The IPL subsystem maintains a list of parts that have been approved for use on JPL projects depending upon the mission class of the project. The mission class rating of each part is maintained as part of the IPL. The IPL system references all parts that have been procured by JPL through Section 514 and indicates the parts' mission class rating as well as other pertinent parts information. Parts on the IPL can be used on projects with an equivalent or lower mission class rating with no additional "qualification". The parts on the IPL can be used as the basis for parts entered in parts lists by design engineers and Project offices through the EPL system.

The Approved Parts List (APL) system is a subset of the IPL and is used to maintain a reference data base of both standard and nonstandard parts that have been approved for use on a specific project or subsystem within a Project. The APL differs from the IPL in that the IPL is the repository of institutional parts information. A project's APL will be the basis for creating Electronic Parts Lists for that project. APLs are created and maintained by the Section for the various Project offices.

6.6.3.2 Parts Review System (PRS)

The Parts Review System (PRS) is a collection of application programs whose primary objective is providing parts review information and status to be used in conjunction with the development of the Electronic Parts List (EPL). It contains information to track Waivers, NSPARs, preliminary parts reviews by Specialists, Failure Analysis results, etc. This system interfaces with the Preliminary EPL (PEPL) system prior to parts being transferred to the EPL system. The list of application data bases include:

- Failure Analysis / Destructive Parts Analysis
- Nonstandard Parts Approval Request (NSPAR) Tracking
- Parts List Review

- Specification Generation and Tracking

6.6.2.3 Pre-Electronic Parts List (PEPL)

The PEPL system is used to directly interface the output of electronic assembly designers CAD/CAM system into the Electronic Parts List of EPINS. This is to provide an easier interface for design personnel to interface parts list requirements to the Section.

6.6.3.4 Electronic Parts List (EPL) System

The EPL system is the mechanism by which parts lists, other than direct output of CAD/CAM systems into PEPL, can be submitted to Section 514 for review and eventual procurement. The EPL enables design engineers to receive data on parts during the preliminary design phase before the procurement process begins. Design engineers can enter parts on the EPL electronic data base maintained in Section 514. The EPL data base is linked to other data bases that provide information on Alerts, Waivers, NSPARs, failure analysis, destructive physical analysis, and radiation testing data. Parts entered into the EPL are reviewed to determine whether or not they qualify for use on a specific project or subsystem. As information about the parts becomes available, the design engineer's electronic parts list is refined, and at the appropriate time parts can be selected for procurement. This triggers an interface to the Parts Tracking system (PTS), which then tracks parts through all phases of procurement.

The EPL also has the capability for consolidated parts list analysis. For example, several design engineers might be working on a project, each with responsibility for a particular subsystem. These design engineers will have their own parts lists. A consolidated parts list analysis can be created using the information contained in the individual electronic parts lists.

6.6.3.5 Parts Tracking System (PTS)

The PTS system is the application that tracks each part through the entire procurement cycle. Parts tracking formally begins when a Part Acquisition Screening Order (PASO) is initiated and continues through the various stages of procurement until the part is kitted for delivery. These stages include PASO generation, acquisition, screening, quality assurance, and kitting for delivery. Through its interface to the Electronic Parts Quality Assurance (EPQA), PTS can track parts to the lot level. This information can be used for risk management and risk evaluation in the event of a part failure or subsequent information indicating possible problems with a specific part.

6.6.3.6 Electronic Parts Quality Assurance (EPQA) System

The EPQA system is the application through which lot and serial number information is entered into EPINS. However, serial numbers are not tracked for accepted parts except by range. Serial numbers for rejected parts are tracked unless all or a majority of the lot is rejected. Section 512, Electronic Parts Quality Assurance, updates the PTS data base through this application system. PTS prints a Part Pedigree Traveler (PPT) form for each line item on a PASO. The EPQA subsystem also provides for the creation and tracking of Part Inspection / Review Certification (PIRC) and Special Test Review Certification (STRC) data base records. Non-Conforming Material Reports (NCMRs) are also entered and tracked through the EPQA system. These forms are directly linked to the PTS data bases.

6.6.3.7 Management Reporting System (MRS)

Each EPINS system includes extensive standard reporting capabilities. The user typically has the option to choose the order of the data within the report, the ranges of values to be

reported, the output format, and whether the report is to be run in detail or in summary format. EPINS also includes an extensive multifile custom report writer to allow users to design other custom reports. The majority of the management level reports are accessed through the Management Reporting System (MRS).

6.6.3.8 Financial Analysis System (FAS)

A number of applications have been developed within Section 514 to facilitate the financial management activities of the Section. These applications include a Time Card and Work Order Entry-system and a currently existing Symphony based spreadsheet application to help automate SRM preparation. The Section also uses the RMIS application to review financial and work force data from the MASS/SAS system. The FAS includes the Time Card / Work Entry system plus an expansion and conversion to Excel of the spreadsheet. The new system will allow the generation of cost estimates, via simulated SRMs, and the consolidation of these simulated spreadsheets to allow forecasting of required Section financial resources.

6.6.3.9 Global Files System (GFS)

Certain files within EPINS are used as lookup or reference tables and thus have a significant effect on all of the data existing in the system. An example of such a table is the "Generic Control" file which contains the list of part generics that have been approved for use in the system. In order to provide proper control and security, these files that have been grouped into a separate module An administrator is designated for each file to ensure the integrity of the data and to ensure that discrepancies are corrected and that- new entries are properly and expeditiously entered.

6.6.3.10 Additional Data Bases Within EPINS

The following additional data bases are maintained within the EPINS system by their own application systems:

- Alert / Concerns System (ACS).
- Section 514 Document Library
    - Institutional Parts Requirements (D-5357)
    - Requirements Compliance Matrix, etc.
- Radiation Data Base (RADATA)
- Minority S & E data Base (RESOURCE)

6.6.3.11 Additional Data Bases Accessible by EPINS

The following additional data bases are maintained outside of the Section. Data from these systems is periodically used to update EPINS.

- MASS / SAS
- Project Stores data.

EPINS also has the capability of accessing other data bases with information that can be linked by part number and used for reference purposes (e.g., the Motorola Electronic Parts Data Base and NASA's Electronic Parts Information Management Systems -EPIMS) .

Some of the above data bases are based on information generated within JPL, while others are based on information external to JPL. These data bases are linked to the major EPINS data bases and to each other through the use of descriptors, generic part numbers, or actual part numbers.

6.6.3.12 DOS Application Software

DOS Application Software consists of manufacturers data provided by commercial services and various other commercial spreadsheet, graphics, word processing, and commercial application programs.

6.7 PART PEDIGREE SYSTEM

The Part Pedigree System (PPS) is the mechanism used by the Section to certify that the electronic parts supplied by the Section comply with all of the prescribed part quality and reliability requirements of the program for which they are intended.

6.7.1 PPS Documentation

The PPS is composed of four types of records, the responsibility for which is shared by Section 514 and Section 512 (EPQA), and which document the requirements of each procurement line item and certifies that all of the requirements have been met. The four records are briefly described below. The Parts Pedigree System flow and the relationship among these four records is shown in Figure 6-10. EPQA maintains files of these records and a data base to track them. A complete description of the Part Pedigree System is given in JPL document 51-PPS01-0, *Parts Pedigree System Plan* and in 51-D-02, *JPL High Reliability Parts Acquisition Process.*

6.7.1.1 Part Pedigree Traveler (PPT)

The Parts Representative prepares a PPT for each line item of the PR. The PPT lists the various tests and inspections which must be passed before the parts can be classified as flight worthy for the intended program. The Parts Specialists reviews and approves this prior to sending it to EPQA.

6.7.1.2 Part Inspection / Review Certification (PIRC)

When the parts are received (or at some point prior to that), the Parts Representative prepares a PIRC, which will serve as the central record of visual inspections, data reviews, and results of any tests required by the PPT. EPQA is responsible for making certain that the necessary reviews have taken place and been recorded on the PIRC.

6.7.1.3 Test Data Summary (TDS)

The TDS is the responsibility of Section 514 (however, it may be initiated and completed by a screening vendor). It provides a record of additional electrical screening of flight parts after initial receipt from the part supplier. This data is then reviewed and certified by the Parts Specialist.

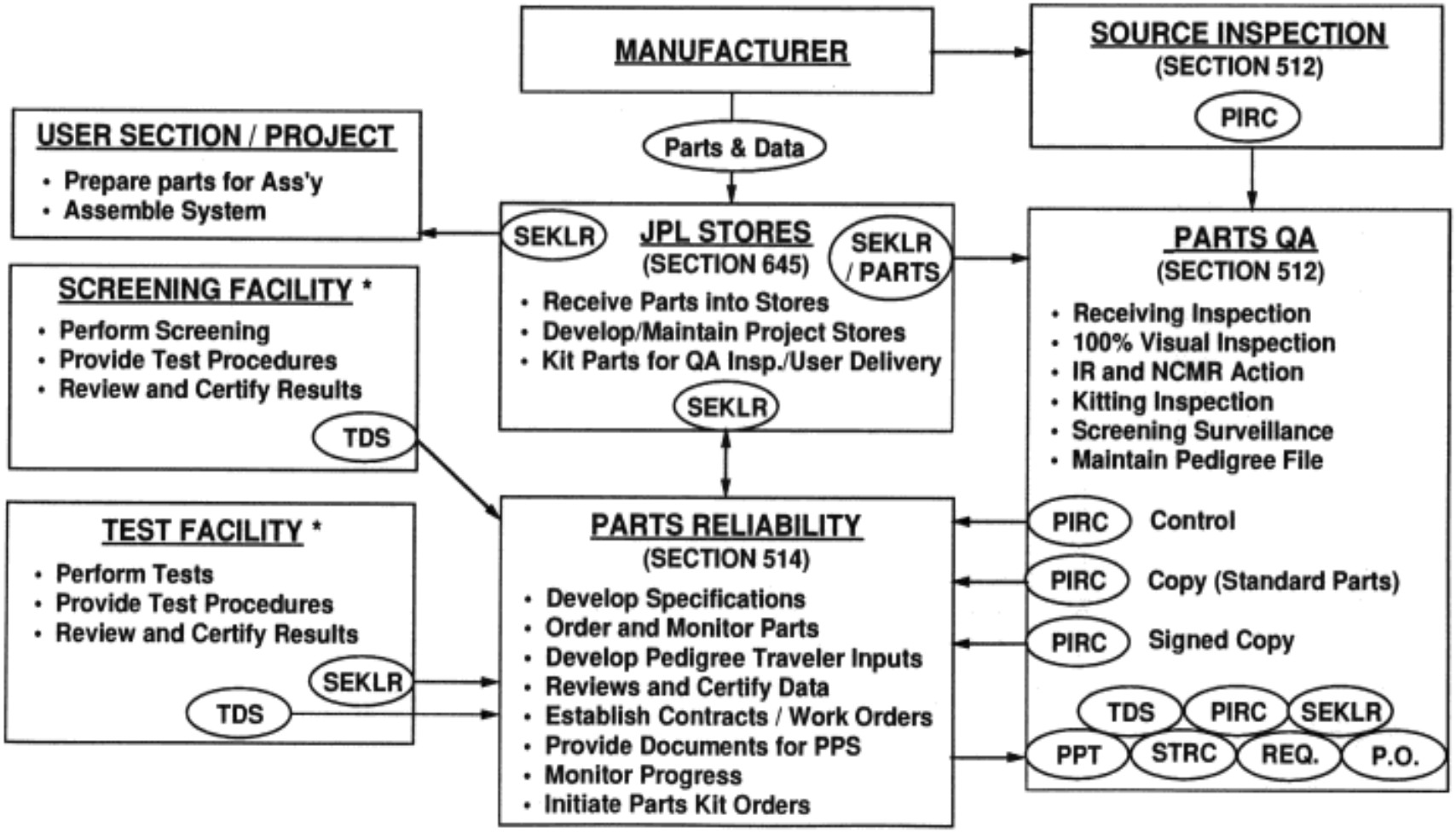
6.7.1.4 Special Test Review Certification (STRC)

The STRC prescribes documents and certifies the results of each special test of flight parts

ELECTRONIC PARTS RELIABILITY

PARTS PEDIGREE SYSTEM

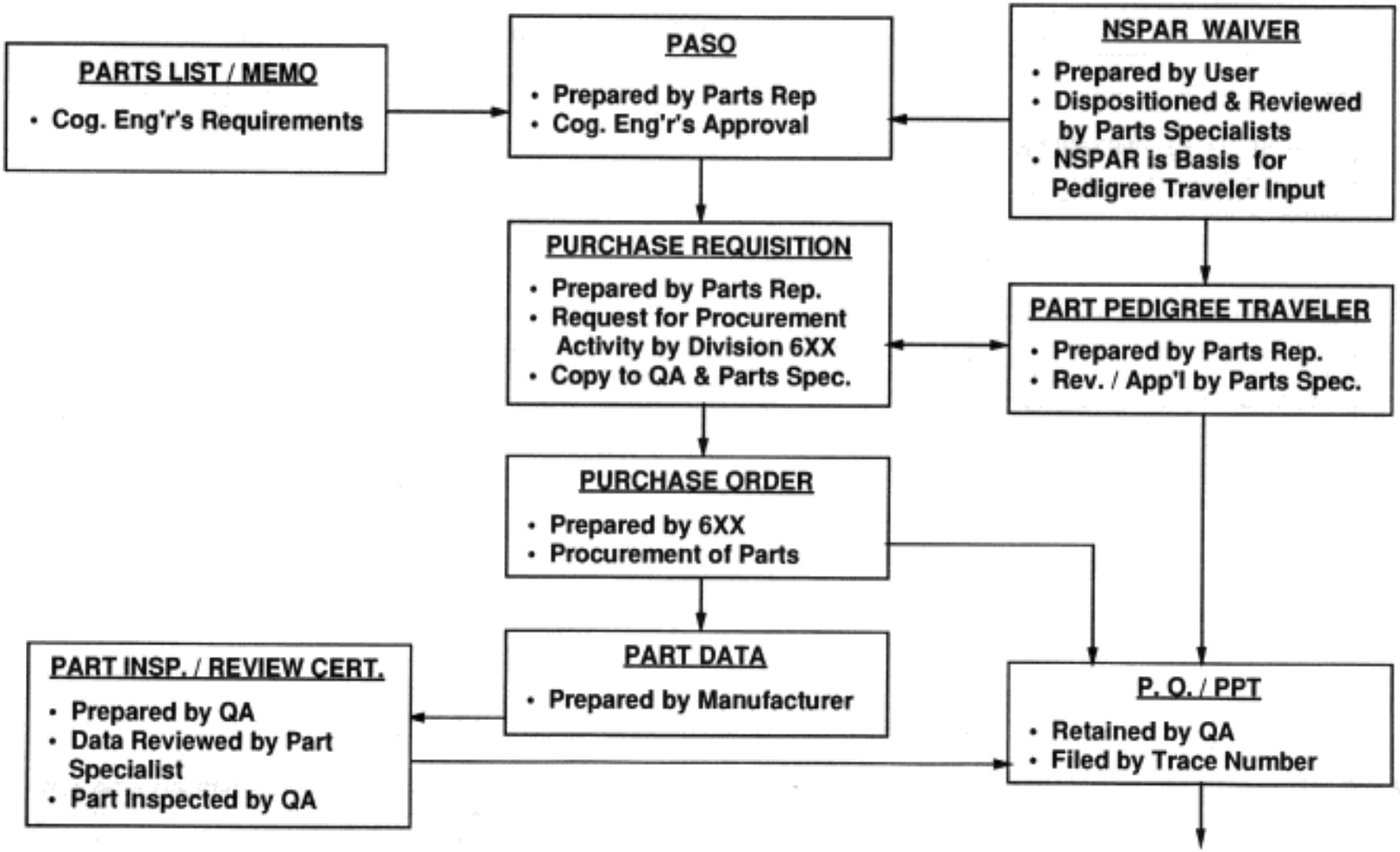
RESPONSIBILITIES



* May be Performed by Section 514
⬭ Indicates Document Flow

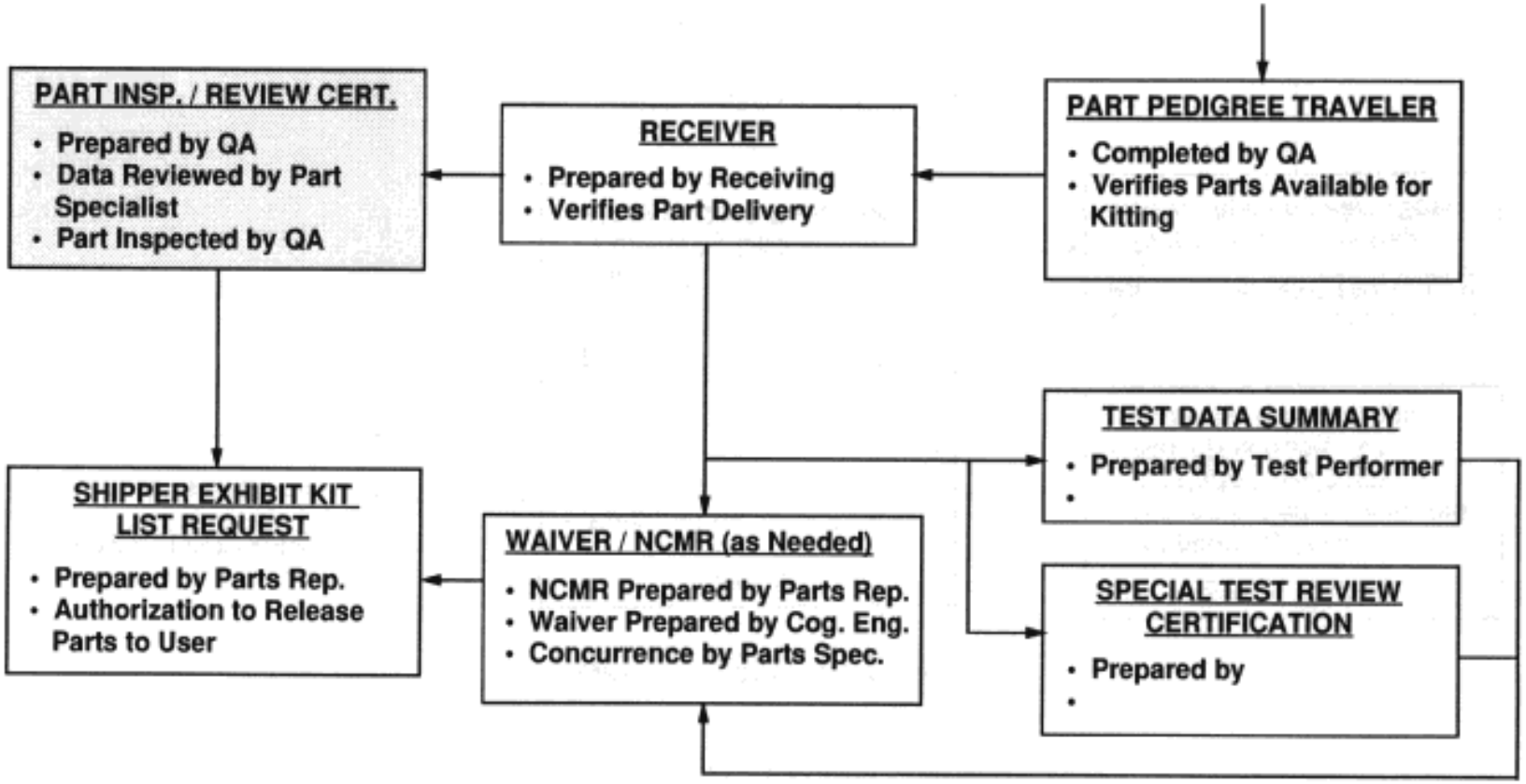
PARTS PEDIGREE SYSTEM

DOCUMENT FLOW



PARTS PEDIGREE SYSTEM

DOCUMENT FLOW



or evaluation of lot samples by JPL or an outside vendor, after initial receipt of parts from a supplier.

6.7.5 Parts Pedigree Records and Reporting

The various PPS records recited in this section are accumulated to comprise the Parts Pedigree System File. JPL Parts Quality Assurance maintains these records and a database and provides weekly and periodic reports to Parts Reliability and the users.

A Records Storage and Retention Plan assures safe closure of pedigree files on inactive stock. Quality Assurance sends records to storage, and Parts Reliability assumes cognizance of these documents.

6.7.6 Defect Trend Analysis

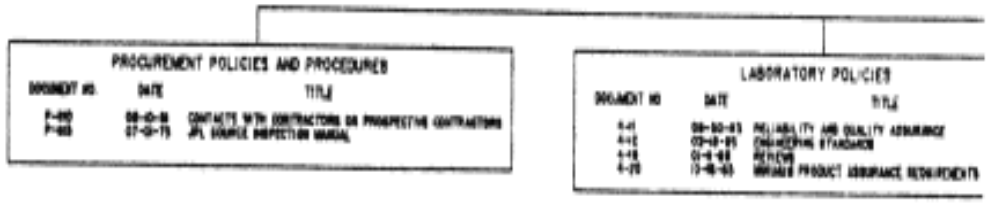
The Parts Pedigree Plan embodies several tools that may potentially be used to assess operational performance and to provide visibility to potential impacts on present and future projects. Defect trend analysis is one such tool with which problem trends may be identified.

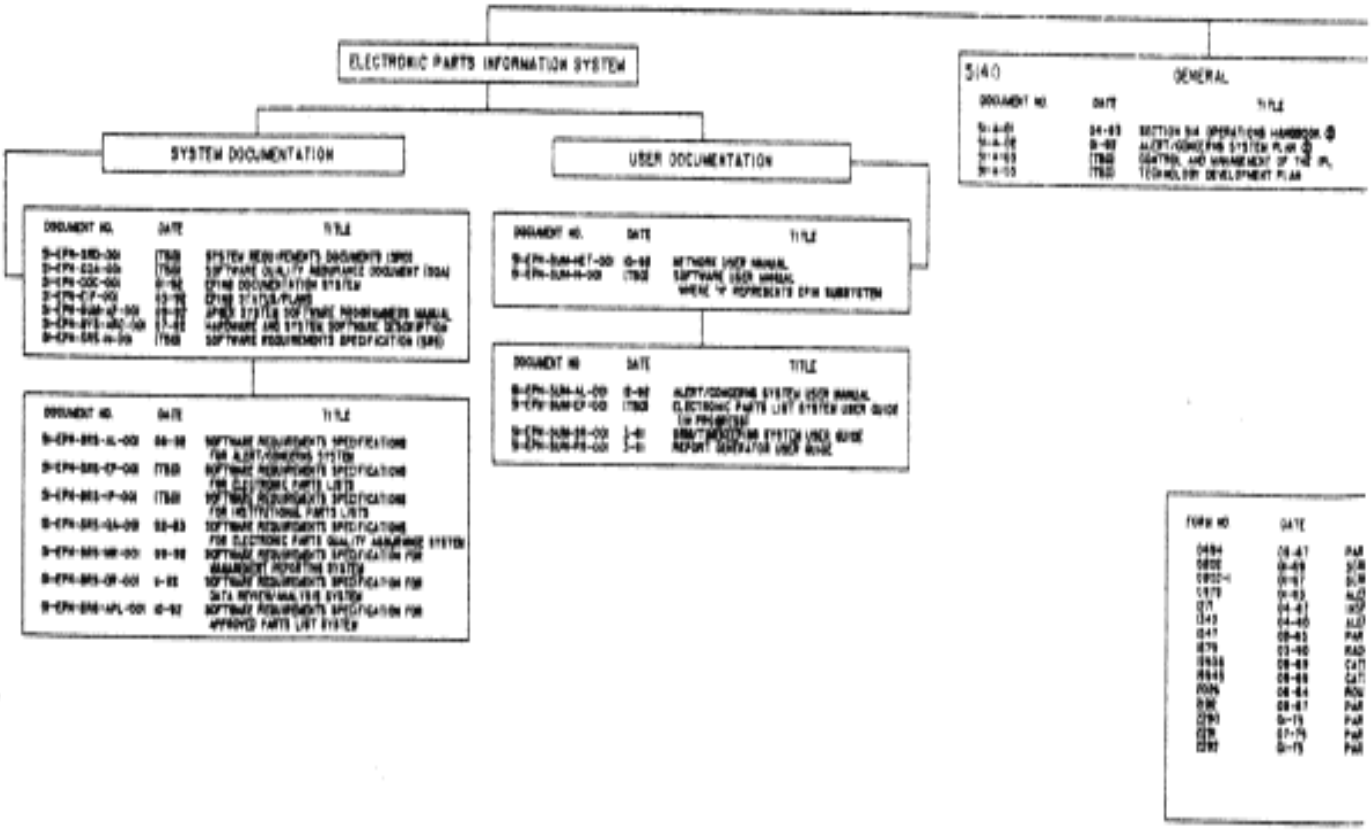
Data gathered on PPT paperwork during parts inspection, test data review, evaluations, or failure analysis is contained in the JPL Parts Quality Assurance Data Base. Automated reports can be generated on select defect trends: by part types, manufacturer, trace and lot numbers, quantities, defect category, point of inspection or test, test type, probable cause of failure, and the final disposition. Reports can be obtained that address individual projects as well as provide global institutional part trend analysis.

The Trend Analysis database is linked with (EPINS). EPINS allows access to the Parts Failure Analysis database and the Parts Tracking System to aid in expediting assessment of defect trends and their impacts on Projects.

APPENDIX A-1

DOCUMENT TREE


PROCUREMENT POLICIES AND PROCEDURES
DOCUMENT NO.
DATE
TITLE
LABORATORY POLICIES
DOCUMENT NO
DATE
TITLE


ELECTRONIC PARTS INFORMATION SYSTEM
SYSTEM DOCUMENTATION
USER DOCUMENTATION
5140
GENERAL
DOCUMENT NO.
DATE
TITLE
FORM NO
DATE

ELECTRONIC PARTS RELIABILITY DOCUMENTATION TREE

NASA DOCUMENTS

DOCUMENT NO	DATE	TITLE
NHB 5300.4(1B) ①	10-84	RELIABILITY PROGRAM PROVISION FOR AERONAUTICAL AND SPACE SYSTEMS CONTRACTORS
NHB 5300.4(3B-2)		SAFETY, RELIABILITY, MAINTAINABILITY AND QUALITY PROVISIONS FOR THE SPACE SHUTTLE PROGRAM
NHB 5306.4(3F)	1-88	EEE PARTS MANAGEMENT AND CONTROL
NSA 33015	8-77	ALERTS
NSA 3300.2B	8-77	USEP PARTICIPATION
NSA 2220.3A	-84	BASIC POLICY FOR ELECTRONIC PARTS
NSA 1320.2A	8-69	STANDARD PARTS PROGRAM
NSA 8010.1A	3-76	CLASSIFICATION OF NASA SPACE TRANSPORTATION SYSTEM (STS) PAYLOADS
MIL-STD-975A	3-93	NASA STANDARD EEE PARTS LIST

JPL POLICIES AND PROCEDURES

STANDARD PRACTICE INSTRUCTIONS

DOCUMENT NO	DATE	TITLE
4-03-05	04-84	DISPOSITION OF DISCREPANT MATERIAL/EQUIPMENT
4-04-07	04-84	EQUIPMENT FROM JPL
4-04-11	04-84	RELIABILITY ASSURANCE
4-04-3	04-84	FAILURE/DEFECT REPORTING
4-04-4	04-84	SELECTION OF ELECTRONIC PARTS
4-04-5	1-84	CONTROL OF ELECTROSTATIC DISCHARGE
4-04-7	08-86	ENGINEERING STANDARDS
4-05-1	02-83	NASA ALERT SYSTEM
5-05-16	04-84	

DIVISION CHARTER

DOCUMENT NO	DATE	TITLE
350-13	08-86	HARDWARE ASSURANCE DIVISION

PARTS PROGRAM PLANS

SPACECRAFT PLANS

DOCUMENT NO	DATE	TITLE
520-01	04-90	BALLISTIC PARTS, MATERIALS & PROCESSES
612-PWP-001	12-89	WIRE DESIGNER PARTS, MATERIAL AND PROCESS
613-153	03-89	TOPEX
PWP-003-015	10-89	MARS-94
699-005	04-92	DRAF/CLASS-01 PARTS PROGRAM REQUIREMENTS
699-514A	01-92	DRAF/CLASS-01 APPROVED PARTS LIST

SCIENCE

DOCUMENT NO	DATE	TITLE
D-9920	03-92	APPROVED PARTS LIST FOR EOS INSTRUMENTS
D-7989	12-92 DRAFT	PARTS PROGRAM REQUIREMENTS FOR EOS INSTRUMENTS

SECTION 514 PROCEDURES

5141/5 ENGINEERING

DOCUMENT NO	DATE	TITLE
5-5-01	07-90	PARTS SPECIALIST REVIEW GUIDELINES
5-5-02	7-90	PARTS REVIEW SYSTEM REQUIREMENTS
5-5-03	(TBD)	MAINTENANCE REVIEW GUIDELINES
5-5-03	(TBD)	GUIDELINES FOR PREPARING SPECIFICATIONS FOR (EEE)ONIC PARTS
5-5-03	(TBD)	SCREENING AND LOT ACCEPTANCE OF NONSTANDARD PARTS.
JPL-9573-XEX REV L	02-92	GENERAL SPECIFICATION FOR
JPL-9573-XEX	DRAFT	ASIC AND HYBRID DESIGN REVIEWS
5-5-04	(TBD)	QUALIFICATION REQUIREMENTS FOR JPL

5142 FAILURE ANALYSIS

DOCUMENT NO.	DATE	TITLE
MIL-STD-750C	10-08-87	TEST METHODS FOR SEMICONDUCTOR DEVICES
MIL-STD-883C	08-08-88	TEST METHODS AND PROCEDURES FOR MICROELECTRONICS
MIL-STD-1580A	12-02-84	DESTRUCTIVE PHYSICAL ANALYSIS FOR EEE PARTS
JPL-9578-XEX	-90	GENERAL SPECIFICATION FOR DESTRUCTIVE PHYSICAL ANALY OF ELECTRONIC PARTS

FORMS

TITLE
TS IDENTIFICATION TAG
EMING CONTRACTOR SUMMARY TEST REPORT
EMING CONTRACTOR SUMMARY TEST REPORT LOT# SHEET
T RECOMMENDATIONS
ECTION B TEST REQUEST
T SUMMARY
SPECIALISTS PARTS RATING AND RECOMMENDATIONS
ATION EFFECTS AND TESTING WORK ORDER
EQUEST + WAIVER REQUEST
EQUEST & WAIVER REQUEST
T SHEET
E INFORMATION PROGRAM
USAGE AND APPLIED STRESS DATA CEX PURP
USAGE AND APPLIED DATA CAPACITORS - FIXED AND VARIABLE
USAGE - APPLIED STRESS DATA DIODES SIGNAL, MIX PURP-SECTION

FORM NO.	DATE	TITLE
2293	3-75	PART USAGE AND APPLIED STRESS DATA DIODE - ZENER
2297	0-88	PART USAGE AND APPLIED STRESS DATA RESISTORS - FIXED
2299	03-75	PART USAGE AND APPLIED STRESS DATA TRANSISTORS - JFET
2300	1-75	PART USAGE AND APPLIED STRESS DATA DIGITAL - CMOS
2302 P1	9-76	PART USAGE AND APPLIED STRESS DATA DIGITAL MICROCIRCUITS
2303 P2	9-76	PART USAGE AND APPLIED STRESS DATA DIGITAL MICROCIRCUITS
2305 P1	05-86	PART USAGE AND APPLIED STRESS DATA LINEAR MICROCIRCUITS
2305 P2	04-91	PART USAGE AND APPLIED STRESS DATA LINEAR MICROCIRCUITS
2311	03-72	PART USAGE AND APPLIED STRESS DATA TRANSISTORS
2403-1	10-88	STANDARD COST DIST / EEE PARTS WITH SECTION 514 ONES PRINT
2705	10-83	RADIATION TEST REQUIREMENTS
3019	0-88	ENVIRONMENTAL HISTORY
	01-73	PROJECT PARTS ENGINEERING DOC RATING
3293	(TBD)	WAIVER EXHIBIT OF LOT REJECT
3297	04-87	ELECTRONIC PARTS INSPECTION REPORT
3298	03-92	OUTGOING TEST TRAVELER REPORT

FORM NO.	DATE
5-05-0-	(TBD)
5-05-03	(TBD)
5-05-03	(TBD)
5-PP501-1	04-93
5-PP501-2	04-93
5-PP501-3	04-93
5-PP501-4	04-93
05-930	05-93
05-2002	05-93

SECTION CHARTER

DOCUMENT NO.	DATE	TITLE
518-0	02-88	ELECTRONIC PARTS RELIABILITY SECTION

OTHER JPL DOCUMENTS

DOCUMENT NO	DATE	TITLE
D-363 D-4348	—— ——	REVIEWS ELECTROSTATIC CONTROL FOR ASSEMBLY AND TEST AREAS FOR FLIGHT PROJECTS
D-44898	01-90	FLIGHT EQUIPMENT CLASSIFICATION AND PRODUCT ASSURANCE REQUIREMENTS
D-2005C	10-89	JPL ENGINEERING STANDARDS REFERENCE LIST
D-4000 REV. B	12-88	JPL SOFTWARE MANAGEMENT STANDARDS
D-4685	10-88	FLIGHT INSTRUMENT PROBLEM/FAILURE REPORTING AND MANAGEMENT
D-44868	01-90	FLIGHT EXPERIMENTS PROJECT/TASK REVIEW PROGRAM
D-1357 (DRAFT)	——	ELECTRONIC PARTS PROGRAM REQUIREMENTS
D-8945	08-88	STANDARDS FOR WAIVER REQUESTS
STD000020	01-89	ENGINEERING STANDARD, PREPARATION OF HARDWARE SPECIFICATIONS
STD000088	12-1-89	ENGINEERING STANDARD, JPL VENDOR IDENTIFICATION CODING

OTHER PLANS

DOCUMENT NO.	DATE	TITLE
5-A-01	04-83	SECTION 314 OPERATIONS HANDBOOK Ⓓ
5-A-02	01-92	ALERT/CONCERN SYSTEM PLAN Ⓓ
5-PP&D-0	04-90	PARTS ASSURANCE SYSTEM PLAN Ⓓ

5143 RADIATION EFFECTS AND TESTING

DOCUMENT NO.	DATE	TITLE
ASTM F1192-80	12-88	STANDARD GUIDE FOR THE MEASUREMENT OF SINGLE EVENT PHENOMENA FROM HEAVY ION IRRADIATION OF SEMICONDUCTOR DEVICES
DMD09306C VOL II, APPX A MIL-STD-883 METHOD 1019.4	03-88	ESD CONTROL STEADY STATE TOTAL DOSE IRRADIATION PROCEDURES
SSP30420	(TBD)	SPACE STATION ELECTROMAGNETIC, IONIZING RADIATION AND PLASMA ENVIRONMENT DEFINITION AND DESIGN REQUIREMENTS
SSP30512	(TBD)	SPACE STATION IONIZING RADIATION EMISSION AND SUSCEPTABILITY REQUIREMENTS
SSP30513	(TBD)	SPACE STATION IONIZING RADIATION ENVIRONMENT EFFECTS TEST AND ANALYSIS TECHNIQUES
ZPP-2017-GEN	(TBD)	ELECTRONIC PARTS RADIATION PROGRAM REQUIREMENTS FOR FLIGHT PAYLOADS
5I-E-03	DRAFT	GENERAL PROCEDURE FOR QUALIFICATION AND SELECTION OF SCREENING VENDORS
SSP30540	1-91	SPACE STATION SYSTEMS REQUIREMENTS FOR IONIZING RADIATION ENVIRONMENT COMPATIBILITY

5144 PROJECT PARTS SUPPORT

DOCUMENT NO	DATE	TITLE
5I-0-01	(TBD)	NSPAR PREPARATION AND PROCESSING
5I-0-02	(TBD)	JPL HIGH RELIABILITY ELECTRONIC PARTS AND ACQUISITION PROCESS
5I-0-03	(TBD)	GUIDELINES FOR KITTING OF FLIGHT ELECTRONIC PARTS AND RETURNS OF SURPLUS RESIDUALS PARTS TO STORES
5I-0-04	(TBD)	GUIDELINES FOR TECHNICAL MANAGEMENT OF ELECTRONIC PARTS CONTRACTS

TITLE
OARD PARTS APPROVAL REQUEST
QUISITION AND SCREENING ORDER
UEST
DBREE TRAVELER
SPECTION/REVIEW CERTIFICATION
TA SUMMARY
TEST REVIEW CERTIFICATION
DATA REQUEST

NOTE #1: MANDATORY
#2 SHOWN IN TWO LOCATIONS

QTY REQD	ITEM NO	REF DES	CAGE NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE

PARTS LIST

NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
ANGLES ± 1/2°
MACHINE FINISH ✓
DO NOT SCALE DRAWING
INTERPRET DWG PER MIL-STD-100
MATERIAL

CONTRACT NO
APPD DATE
DWN G. CLOUGH 04-6-90
CHK
STRUCT
MATL
ENGR
DESIGN AUTH

JET PROPULSION LABORATOR
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109
RELEASED THROUGH SECTION 356

SECTION 514
ELECTRONIC PARTS
RELIABILITY
DOCUMENTATION TREE

SIZE	CAGE NO	
E	23835	10147746

SCALE			
NONE	UNCLASSIFIED	SHEET	OF

CH.HIX GJC.514.EPR.DOC.TREE.10147746-A

APPENDIX A-2

JPL COMPLIANCE TO NHB5300.4 (1F)

PARTS MANAGEMENT / CONTROL REQ. PARAGRAPH	DESCRIPTION	JPL D-1489	JPL D-5357	OTHER DOCUMENTS
CHAPTER 1-INTRODUCTION				
1F101	Delineation of Organizational Responsibilities	3.0 5.0 5.2	1.0 3.0 8.0	Lab Policy 4-11 Charter 510-C1 Charter 514-C1
1F102.1	Responsibility [Requirements Flowdown]	3.0	3.0 8.0	4-20
1F102.2	Responsibility [In-house Implementation]	3.0	3.0 8.0	
1F103 - 1F106	[Advisory topics]			
CHAPTER 2-PROGRAM MANAGEMENT				
1F200	Parts Management	5.0	3.0 8.0	-
1F201	Parts Control Board	-	2.0	-
1F202	Off-The-Shelf Equipment and New Builds of Existing Designs	-	4.0 5.0 6.1.3	SPI 4-11-6
1F203	Coordinated Procurement	-	-	51-A-01
1F204	Subcontractor Management	-	8.0	-
CHAPTER 3-PARTS REQUIREMENTS				
1F300	Parts Control Plan	5.3.1	3.0 8.0	-
1F301	Parts Selection and Specification	4.0 5.3.2 5.3.8	2.1 4.1 4.2 5.0 6.1 6.3	SPI 4-11-6 51-G-01 ZPP-2073-GEN

PARTS MANAGEMENT/ PARAGRAPH	CONTROL REQ. DESCRIPTION	JPL D-1489	JPL D-5357	OTHER DOCUMENTS
CHAPTER 3-PARTS REQUIREMENTS (Cont'd)				
1F302	Screening	5.3.9	6.1.4 6.1.5 6.2.2 6.2.3	RED-23 ZPP-2073-GEN ZPP-2074-GEN ZPP-2075-GEN ZPP-2076-GEN
1F303	Parts Improvement Program	-	5.0 6.1.3	-
1F304	Parts Lists	5.3.1.1 5.3.3.1	4.0 5.3 7.8	-
1F305	Problem Parts	5.3.6	5.1 6.1.2 6.3 7.6 8.0	 - -
1F306	EEE Parts Derating and Application	5.3.7	7.1	ZPP-2061-PPL
1F307	Problem/Failure Reporting and Correction	5.3.6	6.1.4.4	SPI 4-11-5
1F308	GIDEP Participation	5.3.6	7.6	SPI-7-01-14
1F309	Traceability	5.3.4.2 5.3.4.3	6.1.4.1 7.4	
1F310	Handling, Packaging, Storage, and Shipping	-	7.5	PPD-xxx
1F311	Qualification Maintenance	-	EPINS	-
1F312	Quality Conformance Tests	5.3.8.5 5.3.9.3	6.1.4.7 6.2.3	ZPP-2076-GEN -
1F313	Parts Receiving Inspection	5.3.9.4	6.1.4.10	-
1F314	Supplier Surveillance of Nonstandard Parts	-	6.2.2 8.0	P-813

APPENDIX B

ELECTRONIC PARTS ACQUISITION SYSTEM FLOW

1.0 INTRODUCTION

Outlined below (and in the accompanying chart, *"Electronic Parts System Functional Flow"),* is an abbreviated version of the total parts support process that is contained in 51-D-02," JPL High Reliability Electronic Parts Acquisition Process". The numbers in brackets in the text below refer to the corresponding numbers on the chart. This summary details the major elements of the Section's efforts in support of electronic parts acquisition at JPL.

2.0 PART SELECTION

2.1 Initial Selection

The mission requirements are set by the Project Office. Section 514 implements/audits compliance with the requirements and provides Support for the generation of the Approved Parts List (APL), if required [1].

The Cognizant Engineer designs hardware using as many standard parts as practical and submits the parts selection list for review and approval [2,3,4].

2.2 Section 514 Review

The Section 514 Parts Representative (Parts Rep.) coordinates all phases of the Section 514 parts activity, including the parts list review and the Nonstandard Part Approval Request (NSPAR) review and approval cycle, (i.e., Specialist and radiation review, Project concurrence, and subsequent close out) [5].

The Parts Specialist provides advice on application and recommends alternate parts to aid the cognizant designer [6].

2.3 Standard Part

A standard part is a part included in a program's APL or in the appropriate selection sources of D-5357. [7].

2.4 Nonstandard Part

A nonstandard part is a part not included in a program's APL or (if there is no APL) not included in the standard part selection source of D-5357. It often requires preparation of a Source Control Drawing (SCD). It may require rigorous testing to establish confidence that it meet flight standards established by JPL [8].

A waiver is required when a NSPAR is disapproved. This waiver request is written by the Cognizant Engineer (or by Section 514 if used throughout a project) reviewed by the same agencies as reviewed the NSPAR (and disapproved by those who disapproved the NSPAR), and approved by the Project Office. It is expected that those disapproving the waiver request provide a statement of estimated degree of risk. If the waiver is approved, a procurement is authorized [9].

If a redesign is required because the waiver is not approved, a design change may be required to accommodate a new part selection [10].

This total parts selection process is further illustrated in Figure 1, Parts Selection Process.

3.0 PART ACQUISITION

3.1 Purchased Part

A Part Acquisition and Screening Order (PASO) is a document that authorizes procuring a part type and is also used to initiate the Parts Tracking System (PTS) [11].

The Part Pedigree Traveler (PPT) system documents all the processing steps required to achieve flight status and also documents the completion of each processing step. Without completion of the entire prescribed test / processing, the part will not be kitted for flight usage [12].

The Procurement Requisition (PR) authorizes Procurement to place a purchase order for flight parts [14].

Procurement performs all the procurement actions necessary to effect the buying of flight parts [15].

Receiving is the area where all JPL-procured material is accounted and dispersed [16].

Flight Stores provides a dedicated, controlled area to stock flight project parts. This area receives parts from Receiving, submits received parts to Inspection, and kits parts for delivery to the user [17].

Kitting is initiated by the Section 514 Parts Representative preparing a kit request to Project Stores. Kits are passed through to(QA) for final inspection and verification of pedigree status [18].

Test data are reviewed by the Parts Specialist, and the results are documented in the Part Pedigree System [19,20,21,22,23].

3.2 Inherited Part

The Parts Rep. arranges the transfer of flight parts, using a transfer PASO, from one project Stores to another [13].

4.0 RECEIVING INSPECTION

Quality Assurance provides all the required inspections. It also maintains the part pedigree records that establish the flight worthiness of the flight parts the user receives [24].

5.0 ENGINEERING SUPPORT

Some activities of the Section is support of parts acquisition are not specific to any one phase of the acquisition process but are applicable to the whole process. These umbrella activities are listed below.

5.1 Alternative Source Development

A high risk for many projects during parts acquisition is having only one approved source for a part. When a viable alternate is found, a review, survey, and evaluation are necessary to approve the new source.

5.2 Vendor Evaluations

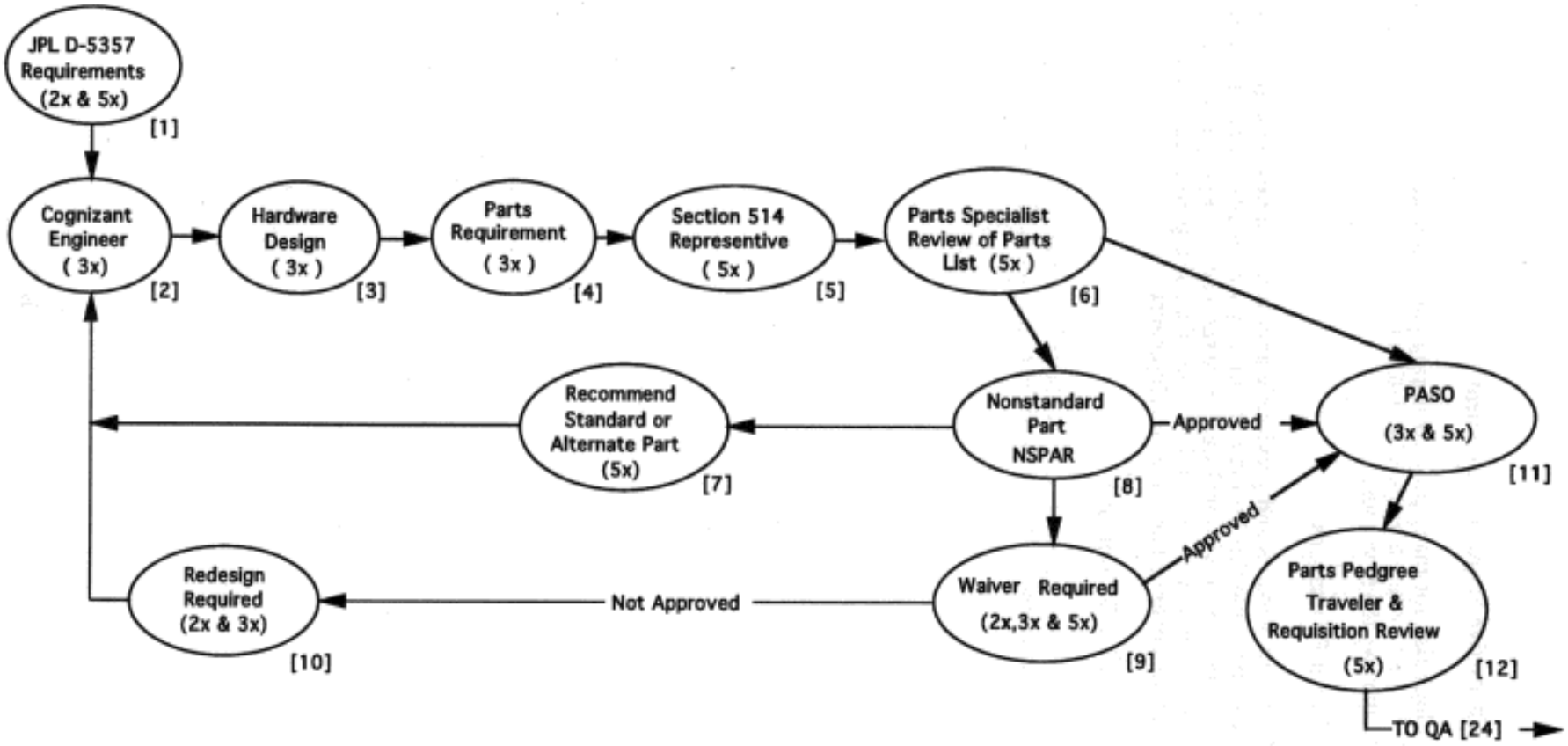
Both new vendors and previously approved vendors must be surveyed to assure that they have the capability to manufacturer space-quality parts. In addition to the verification performed by traditional quality assurance surveys, parts specialists can verify that the manufacturers understand the intent of the JPL parts requirements, while becoming familiar with the personnel and new developments.

5.3 Technical Consultation

Certain functions such as part classification are conducted with the results being used as inputs in assessing the status of the reliability assurance program for the overall project.

ELECTRONIC PARTS RELIABILITY

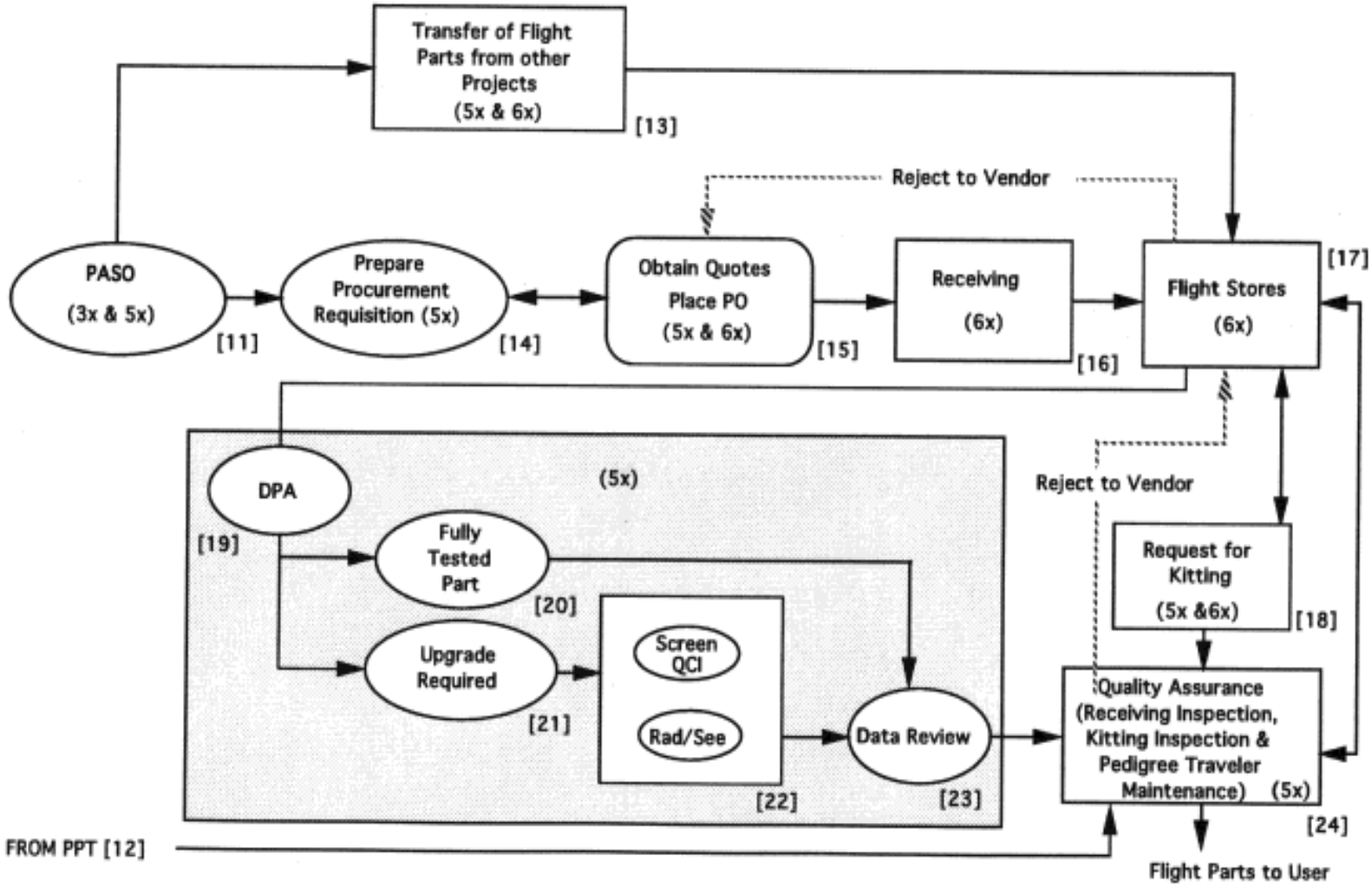
ELECTRONIC PARTS SYSTEM FUNCTIONAL FLOW



B.1a
4/8/93

ELECTRONIC PARTS RELIABILITY

ELECTRONIC PARTS SYSTEM FUNCTIONAL FLOW



APPENDIX C

ACRONYMS

AD	-	ADVANCED DEVELOPMENT
A/D	-	ANALOG TO DIGITAL
ADEOS	-	ADVANCED EARTH OBSERVING SYSTEM (JAPAN)
ALD	-	ASSISTANT LABORATORY DIRECTOR
AMPL	-	ADVANCED MICROELECTRONICS PARTS LIST
APL	-	APPROVED PARTS LIST
ASIC	-	APPLICATION SPECIFIC INTEGRATED CIRCUIT
BB	-	BULLETIN BOARD
BNL	-	BROOKHAVEN NATIONAL LABORATORY
C/C	-	CRAF /CASSINI
CCD	-	CHARGED COUPLED DEVICE
CDR	-	CRITICAL DESIGN REVEW
CDRL	-	CONTRACT DATA REQUIREMENTS LIST
Cf	-	CALIFORNIUM
CODE QR	-	NASA RELIABILITY, MAINTAINABILITY, AND QUALITY ASSURANCE DIVISION
CTM	-	CONTRACT TECHNICAL MANAGER
D/A	-	DIGITAL TO ANALOG
DESC	-	DEFENSE ELECTRONIC SUPPLY CENTER
DID	-	DATA ITEM DESCRIPTION
DLA	-	DEFENSE LOGISTICS AGENCY
DOD	-	DEPARTMENT OF DEFENSE
DOS	-	DISK OPERATING SYSTEM
DPA	-	DESTRUCTIVE PARTS ANALYSIS
DRD	-	DATA REQUIREMENTS DESCRIPTION
DSP	-	DIGITAL SIGNAL PROCESSOR
EDB	-	ENGINEERING DATA BANK
EDMG	-	ENGINEERING DATA MANAGEMENT GROUP
EEE	-	ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL
ELV	-	EXPENDABLE LAUNCH VEHICLE
EMMI	-	EMISSION MICROSCOPE FOR MULTILAYER INSPECTION
EPAG	-	ELECTRONIC PARTS ADVISORY GROUP
EPINS	-	ELECTRONIC PARTS INFORMATION NETWORK SYSTEM
EPL	-	ELECTRONIC PARTS LIST
EPQA	-	ELECTRONIC PARTS QUALITY ASSURANCE (SECTION 512)
EPSC	-	ELECTRONIC PARTS STEERING COMMITTEE
ESD	-	ELECTROSTATIC DISCHARGE
EXACT	-	EXCHANGE OF AUTHENTICATED ELECTRONIC COMPONENT PERFORMANCE TEST DATA
FA	-	FAILURE ANALYSIS
FEDB	-	FAILURE EXPERIENCE DATA BANK -
FPO	-	FLIGHT PROJECTS OFFICE
GIDEP	-	GOVERNMENT-INDUSTRY DATA EXCHANGE PROGRAM
GLL	-	GALILEO
IC	-	INTREGATED CIRCUIT
IDC	-	INDEFINITE DELIVERY CONTRACT
ILAN	-	INSTITUTIONAL LOCAL AREA NETWORK
IPL	-	INSTITUTIONAL PARTS LIST

ITR	-	INSPECTION AND TEST REQUEST
JPL	-	JET PROPULSION LABORATORY
LAT	-	LOT ACCEPTANCE TEST
LBL	-	LAWRENCE BERKELEY LABORATORY
LSI	-	LARGE SCALE INTEGRATED (CIRCUIT)
MASS	-	MANAGEMENT & ADMINISTRATIVE SUPPORT SYSTEMS
MDB	-	METROLOGY DATA BANK
MMR	-	MONTHLY MANAGEMENT REVIEW OR REPORT
MO	-	MARS OBSERVER
MRB	-	MATERIAL REVIEW BOARD
MSREP	-	MICROELECTRONIC SPACE RADIATION EFFECTS PROGRAM
NASA	-	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NCMR	-	NON-CONFORMING MATERIAL REPORT
NHB	-	NASA HANDBOOK
NMI	-	NASA MANAGEMENT INSTRUCTION
NPPO	-	NASA PARTS PROGRAM OFFICE
NPSC	-	NASA PARTS STEERING COMMITTEE
NSPAR	-	NONSTANDARD PART APPROVAL REQUEST
OER	-	OFFICE OF ENGINEERING AND REVIEW
OSSI	-	OFFICE OF SPACE SCIENCE AND INSTRUMENTS
PASO	-	PARTS ACQUISITION AND SCREENING ORDER
PFAR	-	PROBLEM / FAILURE ANALYSIS REPORT
PFR	-	PROBLEM / FAILURE REPORT
PIE	-	PARTS INTERFACE ENGINEER
PIP	-	PARTS INFORMATION PROGRAM
PIRC	-	PART INSPECTION / REVIEW CERTIFICATION
PM	-	PROJECT MANAGER
PPM	-	PARTS PROGRAM MANAGER
PO	-	PURCHASE ORDER
PPP	-	PARTS PROGRAM PLAN
PPR	-	PARTS PROGRAM REQUIREMENTS
PPS	-	PARTS PEDIGREE SYSTEM
PPT	-	PART PEDIGREE TRAVELER
PR	-	PROCUREMENT REQUISITION
PRS	-	PARTS REVIEW SYSTEM
PSC	-	PARTS STEERING COMMITTEE
PTS	-	PARTS TRACKING SYSTEM
QA	-	QUALITY ASSURANCE
QC	-	QUALITY CONTROL
QCI	-	QUALITY CONFORMANCE INSPECTION
QML	-	QUALIFIED MANUFACTURERS LIST
QPL	-	QUALIFIED PRODUCTS LIST
RADATA	-	(JPL) RADIATION DATA BASE
RAM	-	RANDOM ACCESS MEMORY
RFP	-	REQUEST FOR PROPOSAL
RHA	-	RADIATION HARDNESS ASSURANCE
RMDB	-	RELIABILITY - MAINTAINABILITY DATA BANK
R&QA	-	RELIABILITY AND QUALITY ASSURANCE
RTOP	-	RESEARCH AND TECHNOLOGY OBJECTIVES AND PLANS
SAS	-	SUPPLY & SERVICES ACQUISITION SYSTEM
SCD	-	SOURCE CONTROL DRAWING
SEB	-	SINGLE EVENT BURNOUT OR SOURCE EVALUATION BOARD
SEE	-	SINGLE EVENT EXPECT
SEGR	-	SINGLE EVENT GATE RUPTURE

SEKLR	-	SHIPPER-EXHIBIT KIT LIST REQUEST
SEL	-	SINGLE EVENT LATCHUP
SEM	-	SCANNING ELECTRON MICROSCOPE
SEU	-	SINGLE EVENT UPSET
SIR-C	-	SYNTHETIC IMAGING RADAR - C
SNL	-	SANDIA NATIONAL LABORATORY
SOW	-	STATEMENT OF WORK
SPI	-	STANDARD PRACTICE INSTRUCTION
SRM	-	SYSTEM FOR RESOURCE MANAGEMENT
SSD	-	SPACE SYSTEMS DIVISION (AIR FORCE)
SSF	-	SPACE STATION FREEDOM
STD	-	STANDARD
STR	-	SPECIAL TEST REQUIREMENT
STRC	-	SPECIAL TEST REVIEW CERTIFICATION
TAP	-	TECHNOLOGY APPLICATION PROGRAM (OFFICE)
Ts&Cs	-	TERMS AND CONDITIONS
TDS	-	TEST DATA SUMMARY
TDM	-	TECHNICAL DIRECTION MEMO
UDR	-	URGENT DATA REQUEST
TID	-	TOTAL INTEGRATED DOSE
VLSI	-	VERY LARGE SCALE INTEGRATED (CIRCUIT)
WF/PC	-	WIDE FIELD/PLANETARY CAMERA
WPA	-	WORK PACKAGE AGREEMENT